

Education in professional identity formation enhances self-regulated learning: a mixed-method exploratory study from a community-based clinical clerkship in Japan

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Abstract

Background: Previous studies indicate professional identity formation (PIF), or formation of self-identity with internalized values and norms of professionalism, might influence self-regulated learning (SRL). However, it remains unclear whether or not PIF-oriented education can improve SRL in medical students.

Methods: Rural community-based clinical clerkships (rCBCC) for Year 5 (Y5) students in Jichi Medical University (JMU) provide a learning environment where undergraduates will work in future with alumni directly mentoring them. To make rCBCC more PIF-oriented, we created a learning platform using Google Forms and a PIF-oriented teaching manual for mentors. These were designed to help undergraduates articulate future 'self' images as professionals, and have in-depth communication with mentors as role models pertaining to medical professionalism. Forty-one Y5 JMU students experienced PIF-oriented rCBCC, while 41 Y5 control subjects experienced the original format rCBCC. Changes in SRL between the two groups were compared using 15 categories of motivated strategies for learning questionnaire (MSLQ). We also explored how the PIF-oriented rCBCC changed their SRL by thematic analysis of questionnaire and interview data.

Results: A moderate improvement of *intrinsic goal orientation* ($p = 0.005$, $\epsilon^2 = 0.096$) and a mild improvement of *critical thinking* ($p = 0.041$, $\epsilon^2 = 0.051$) were observed in the PIF-oriented rCBCC. Qualitative analysis revealed they started viewing 'professional responsibility' as self-study motivator. Awareness of 'responsibility' led to pursuit of authenticity and medical knowledge applicability, and fostered critical thinking about learning contents. They also began elaborating learning contents in line with processes.

Conclusion: This is the first study showing some effects of PIF-oriented education on SRL improvement. Fostering PIF may be important for stimulating learners' intrinsic SRL behaviors.

Backgrounds

As clinical knowledge advances rapidly, medical professionals need to update knowledge autonomously throughout their professional life. Therefore, self-regulation in life-long learning has become an important competency [1-4].

Self-regulated learning (SRL) is defined as learners' active participation in their own learning process from metacognitive, motivational, and behavioral perspectives [5]. Zimmerman described SRL as a cyclical process composed of three phases. In the forethought phase, students set learning goals and choose strategies for attaining goals. In the performance phase, students monitor and control behavior to attain goals. In the self-reflection phase, students formulate new learning goals and strategies for future similar situations [6, 7].

Because postgraduate medical training cannot prepare learners for every challenge their qualification brings [1, 8], lack of readiness to engage in SRL following primary medical education is problematic [3, 8,

9].

Contextual factors influencing SRL

Thus far, several studies have emphasized learning context determines learner engagement in SRL. Brydges and Butler [3] summarized contextual factors influencing SRL: At the broadest level from cultural and social learning expectations; and within learning environments from pedagogical approaches, specific assignments, learning support, and types of feedback or evaluation. Van Houten-Schat et al. [9] specifically explored contextual factors influencing SRL in the clinical environment, such as available time, characteristics of learning environment (work climate, engagement in team), and patient-related factors.

Matsuyama et al. investigated contextual factors promoting or hampering SRL in medical knowledge self-study [10, 11] among Japanese medical students. According to these studies, identity formation as a future unique professional could promote student self-oriented reflection and acceptance of various learning strategies in a self-regulated manner. Oppositely, teacher-centered and test-oriented contexts in undergraduate education may keep students overly-dependent on teacher rubrics and hamper developing self-image as unique professionals. All in all, their conclusions suggest professional identity formation (PIF) could be a key factor fostering SRL.

PIF-oriented education in the undergraduate curriculum

PIF is defined as formation of 'a representation of self, achieved in stages over time during which the characteristics, values, and norms of the medical profession are internalized' [12]. Cruess et al, advocates of PIF, state it results in individuals considering their clinical environment behavior [12]. However, while many studies have explored outcomes of PIF-oriented medical education regarding professional and unprofessional behaviors [13-15], there are no studies assessing effects of PIF-oriented educational approaches on learning behaviors.

Therefore, we attempted to create a new PIF-oriented education format and measure changes in undergraduates' SRL before and after the PIF-oriented learning experience. We believe educators can acquire evidence for undergraduate-level pedagogies helping students acquire more self-regulated learning behaviors.

The current study

In this study, we investigated changes in SRL after learners received PIF-oriented education based on Matsuyama et al.'s previous research [10, 11]. Results demonstrate awareness of a future unique 'professional self' foster readiness to seek model learning strategies in future practice. Other articles show professional identity robustly forms when role models demonstrate appropriate behaviors and norms for professionalism [14-17].

By combining these aspects, we created a PIF-oriented education format for clinical year students characterized as follows: students (1) observe mentors in future work settings, (2) articulate their future unique 'self' images to form professional identity, and (3) have in-depth communication pertaining to values and norms of professionalism with their mentors regarding workplace-based learning. We hypothesize PIF-oriented education with these three elements could improve SRL (Figure 1).

In this study, we verified this hypothesis using a rural community-based clinical clerkship (rCBCC) at Jichi Medical university (JMU) in Japan. Under the JMU policy, two to three applicants per prefecture are admitted to university with full support of tuition fee from the prefectural government for the six-year curriculum in exchange for working in rural settings of their home prefecture from PGY3 to 9 [10, 18]. We chose the rCBCC in Year 5 curriculum as a setting for this study because this program allows rural physician-to-be students to study in their future work settings (rural hospitals or clinics in their home prefecture) with mentors who are role models and also JMU alumni rural physicians [19]. In order to promote PIF around rCBCC, we created a PIF-oriented learning platform in which each student articulates their future unique 'self' images, and have in-depth communication pertaining to values and norms of professionalism with mentors. We also made an instruction manual for attending JMU graduates to intensify PIF education during the rCBCC. This version of rCBCC was named PIF-oriented rCBCC (PIF-rCBCC). We conducted a comparative study between PIF- and the original rCBCC in 2018 and 2019 (Figure 2). To clarify the purposes of study, we formulated two research questions.

1. *Does PIF-rCBCC improve SRL better than the original format rCBCC?*
2. *If so, how does the PIF-oriented rCBCC improve SRL?*

We conducted a comparative mixed method study to answer these research questions. This study was approved by the university's ethics committee (reference number: 19-001).

Methods

Settings:

Jichi Medical University

Jichi Medical University (JMU) in Japan was founded to educate medical students to become rural physicians. JMU graduates are appointed to a clinic or hospital in medically underserved or geographically-isolated areas during postgraduate years (PGY) 3 to 9, where consultation with specialists and educational instruction from teachers is difficult [10, 18]. Accordingly, they have fewer chances to train their clinical knowledge and skills under systematic instructional programs between PGY 3 and 9. While JMU graduates are supposed to improve medical knowledge and skills in a self-directed manner, JMU undergraduates are not sufficiently ready with SRL for postgraduate settings [10, 11, 20]. Therefore, the university educational board introduced a new program aimed at independent learning at Year 6 [11], and now the attempt has been expanding across school years. PIF-rCBCC is another attempt to promote better SRL.

The original rCBCC

The original rCBCC was introduced in 1998 [19]. It takes place for 2 weeks from late August to early September just after the long summer holidays between the first and second trimester in Year 5. During rCBCC, Year 5 students stay in their home prefecture community hospital or clinic where JMU graduates work. Every year, two to five JMU graduates per prefecture are appointed to be attending doctors for rCBCC based on reputation and motivation for teaching among their prefectural communities. Although JMU faculty organize and manage the program and assure instructional quality, attending JMU graduates determine the program's process. In 2001, standards for learning activities were proposed, which include ambulatory care, home care, hospital care, placement in mobile clinics, on-call work, rehabilitation, health education, health check-ups, vaccination, day services, and placement in welfare facilities (welfare institutions or nursing homes for the aged) [19].

Before the rCBCCs, students had few chances for sufficient communication with their attending doctors. Following the rCBCC, students were asked to submit a report but did not receive reflective feedback from their mentors. There was no platform to communicate what JMU alumni expected undergraduates to learn, and what undergraduates hoped to learn to become medical professionals in their future setting. Therefore, although the original rCBCC provided an advantageous setting for PIF from learners' future role models (Figure 1), we were concerned the lack of communication might interfere with establishing professional identity as rural physicians.

PIF-rCBCC

In order to make learning contexts of rCBCC more PIF-oriented, we introduced a PIF-oriented communication platform designed in accordance with two other core elements in Figure 1: articulating future 'self' images as 'professional' to form professional identity, and having in-depth communication pertaining to values and norms of professionalism with mentors.

We used an online communication platform or Google Forms because we expected students and mentors to post opinions and feelings frequently with each other. The structure of Google Forms for PIF-rCBCC is described in Add. File 1.

In Google Forms, participants were asked to post essays to verbalize their future self-image and receive feedback from mentors. Also, they were asked to fulfill the professional identity essay (PIE) invented by Kalet, et al. [21]. PIE is useful for helping learners articulate their values and norms about medical professionalism from their own point of view and to help teachers provide feedback by referring to rubrics based on Kegan's constructive developmental theory [21, 22]. This study used a Japanese version of Kalet et al.'s PIE form originally in English. Back translation between English and Japanese was conducted by the main author (YM, Japanese) and an American professor living in Japan literate in both English and Japanese (AJL).

Prior to PIF-rCBCC, mentors received an instruction manual explaining in detail the aim of PIF-rCBCC and the program from receiving the first student submission on Google Forms in July to the final provision of reflective feedback to students in September (Figure 2). The outline of the manual was shown in Add. File 2.

Aside from iterative message exchanges in Google Forms before and after the clinical clerkship, students in PIF-rCBCC were asked to create one or more learning themes during rCBCC based on verbalized future self-images and values and norms of medical professionalism. In response to learners' themes, alumni mentors observed their learning and gave just-in-time feedback during the two weeks of rCBCC. Also, mentors showed students how to overcome future workplace challenges through self-study. Aside from these directives, mentors were basically allowed to educate students in their own ways.

After the two-week clerkship, students were asked to re-articulate their own future images as medical professionals re-writing Kalet's PIE and receiving comments from JMU graduates' feedback on them by Google Forms.

Subjects

Participants and design

As figure 2 shows, we first selected attending rural physicians for PIF-rCBCC. In 2018 and 2019, ninety-four JMU graduates registered as attending graduates for the original rCBCC. Among them, we randomly selected 20 candidates for PIF-rCBCC mentors in 2018 and 2019 and attempted to obtain informed consent for the contribution to PIF-rCBCC in this study. Eventually, 17 and 13 JMU alumni agreed on participation in 2018 and 2019, respectively. Eight alumni participated in both years.

Independent from this study, the JMU Center for Community Medicine matched one alumni with one to three students for the original rCBCC. The thirty PIF-rCBCC alumni were paired with one to three students before informed consent was obtained. In this study, we used students paired with the thirty PIF-rCBCC alumni as candidates for PIF-rCBCC group subjects. There were twenty-two and twenty candidates in 2018 and 2019, respectively. One candidate in 2019 declined the participation. Eventually 41 students were registered as subjects in PIF-rCBCC group (PIF-rCBCCs). Simultaneously, 41 original rCBCC participants (original rCBCCs) control subjects were chosen and provided informed. Participants in both groups were paired by gender and academic ranking from the previous year (Year 4), because previous studies have showed gender [23, 24] and academic performance [25] might independently influence SRL development.

Procedures

We chose a convergent mixed method for the first research question '*Does PIF-rCBCC improve SRL better than the original-rCBCC?*'. A rationale for this method is '*one data collection form supplies strengths to offset the weaknesses of the other form to achieve a more complete understanding of a research problem*' [26]. We used an explanatory mixed method to address the second research question '*How does*

the PIF-oriented rCBCC improve SRL?'. A rationale for this method is that following qualitative approaches can explain quantitative results [26]. We used this method because we believed qualitative analysis would explain how the PIF-oriented rCBCC improved SRL in quantitative data in detail.

1) Quantitative Approach

We measured learners' SRL levels by a Japanese-language version of the Motivated Strategies for Learning Questionnaire (MSLQ-J) [27] before and after subjects participated in PIF-rCBCC or original rCBCC. MSLQ is reported useful measuring SRL in medical undergraduate education [28-30], and is composed of 81 items with seven-point Likert scales quantifying levels of nine types of SRL strategies (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking), and six variables of motivation states (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety). We used 81 items of MSLQ used in a medical school context [29]. All were translated into Japanese and back translations were made between the main author (YM) and an American professor living in Japan literate in both English and Japanese (AJL).

2) Qualitative Approach

To explore change of perception regarding motivation, strategies and reflective behaviors in daily self-study before and after the PIF-rCBCC, we created a questionnaire composed of seven questions (shown in Add. File 3). In 2019, we also conducted one-on-one interviews after analyzing qualitative data from the questionnaire from 41 participants in 2018 and 2019 to achieve data saturation [31]. We employed three interviewers who are familiar with the original rCBCC but not engaged in Year 5 students' assessment in order for interviewees to openly articulate their own perceptions. We asked all PIF-rCBCCs in 2019 to join the interviews and twelve students agreed to have interviews. Interviews were conducted in a semi-structured manner using an interview form with similar questions to those in the questionnaire (shown in Add. File 3). The interviewers were told by the main author (YM) beforehand to obtain data about change of perception regarding motivation, strategies and reflective behaviors. After collecting interview data from 10 students, the two main authors (YM and HO) found no additional meaningful codes emerging and concluded data reached saturation [31] and stopped interview data collection.

Analysis

1) Quantitative Approach

We compared the 15 MSLQ-J pre-course subcategory scores of PIF-rCBCCs and original rCBCCs subjects using Kruskal-Wallis one-way analysis of variance (ANOVA). After confirming there were no statistically significant differences between the two groups, we compared subtracted (post-pre) scores in the 15 MSLQ-J subcategories between PIF-rCBCCs and original rCBCCs using Kruskal-Wallis one-way ANOVA. A p-value < 0.05 was considered statistically significant. The effect sizes for comparisons were also calculated using ϵ^2 values where small effect sizes ranged from 0.01 to <0.08, medium effect sizes ranged from

0.08 to <0.26 and large effect sizes from ≥ 0.26 . We used JAMOVI version 1.0.7.0 [32] for the statistical analysis.

2) Qualitative Approach

From a constructivist paradigm in which 'reality' is subjective and context-specific, and multiple truths are constructed by and between people [33], qualitative data from the questionnaire and interviews were analyzed using constructivist thematic analysis. We coded anonymized transcripts of the Japanese scripts in accordance with the six phases proposed by Braun and Clarke [34]. Initial coding was conducted by the two Japanese researchers (YM and HO). YM was the lead author, who engages in the development of PIF-rCBCC and had experienced qualitative studies relevant to SRL. HO was chosen to conduct initial coding because he is not directly engaged in the rCBCC program but had experienced qualitative studies relevant to SRL. The transcripts were thoroughly read and analyzed using an inductive coding approach until agreement on coding was achieved through repetitive face-to-face meetings between the pair.

We specifically focused on changes of SRL (motivation, learning strategies, and reflective behaviors) and PIF (individual identities as a medical professional), and attempted to explore how they think changes occurred or what they feel the changes are attributed to. Representative codes and statements were translated into English by an American professor living in Japan literate both English and Japanese (AJL). In the final phase, two other authors (JL and CV; education psychologists being familiar to SRL) joined the discussion, and a higher-level synthesis of the codes were made.

Results

1) Quantitative Data

Mean averages, standard deviations, and median averages for fifteen MSLQ-J categories plus gender and academic rank data at pre-program are shown in Table 1. No categories were significantly different between the two PIF- and original-rCBCCs groups.

The subtracted (post- minus pre-program) between-group scores in the 15 MSLQ-J categories are shown in Table 2. Improvement of *1. Intrinsic goal orientation* and *10. Critical thinking* were significantly better in PIF-rCBCCs than original rCBCCs with ϵ^2 values 0.096 ($p = .005$) and 0.051 ($p = .041$), respectively. In these two categories, scores at pre-program were numerically but insignificantly lower in PIF-rCBCCs than original rCBCCs.

2) Qualitative Data

In accordance with qualitative data findings, we first focused on verbatim responses implying *intrinsic goal orientation* or intrinsic motivation, and *critical thinking*. The initial coding started with responses from Q6 in the questionnaire, 'Can you describe the change in motivation for self-study between pre- and

post-PIF rCBCC?’, and from Q3 in the interview, *‘Through PIF-rCBCC, is there any change in self-motivation?’* in order to explore the *intrinsic goal orientation* or motivation among PIF-rCBCCs. Next, the initial coding proceeded with responses to Q5 in the questionnaire, *‘Can you describe the change in methods and strategies you apply to self-study between pre- and post-PIF rCBCC?’* and from Q4 in the interview, *‘Through PIF-rCBCC, is there any change in methods and strategies you apply to self-study?’* in order to explore how the PIF-rCBCC improved critical thinking. Lastly, we further coded responses from the other questions. After the initial coding agreement, we thoroughly reviewed all codes and relevant quotes and analyzed them at the broader thematic level. In the final phase, the other authors (JL and CV) joined the discussion, and a higher-level synthesis of the codes eventually resulted in three major themes corresponding to the second research question; *‘How does the PIF-oriented rCBCC improve SRL?’*

Theme 1. Recognition of professional responsibility as the motivator for daily self-study

Students began to link ‘responsibility’ entailed by future professional roles to reasons for daily self-study on diseases. They viewed in-depth communication with their mentors through the PIF-rCBCC format with PIE helpful for imagining their future professional responsibilities in a positive and objective manner.

At pre-program, PIF-rCBCC subjects tended to limit their learning to within the range of medical knowledge assessed by teachers of the curriculum. After the PIF-rCBCC, they became motivated to expand their area of learning beyond the subjects for testing. Expansion of learning was preparation for *professional responsibility* to meet social expectation and patient needs.

‘Knowing what skills and knowledge the region expect of you, you can create a working image of your future situation, and it becomes motivation to learn about new areas you weren’t aware of before.’ (Questionnaire, 2019-19)

Aside from perceived expanding area of learning subjects, students began to see self-study required for authenticity and applicability of medical knowledge in their future workplace. This was linked to Theme 3.

Theme 2. Strategies toward elaboration by linking their future professional task process to self-study contents

After PIF-rCBCC, students began to imagine what they would do as unique professionals in future medical practice at a task process-based level. Because their vivid future professional image helped them identify deep responsibilities for their professional tasks, they began carefully observing mentors’ complete professional tasks and began to articulate the process of the tasks. That encouraged PIF-rCBCCs to select learning strategies in which they link information in self-study materials to the professional task processes. Even after rCBCC, they kept learning with strategies of linking medical knowledge in self-study materials to professional tasks processes, which is referred to as *‘elaboration’* in MSLQ.

'After training, I began approaching study thinking about what can I do myself. It wasn't just a wide view either, since I was really thinking in detail.' (Questionnaire, 2018-8)

'I've begun thinking about studying to prepare for when patients come, when they come for their first exam.' (Interview, 2C-11)

Theme 3. Critical evaluation of learning objects to pursuit authenticity and applicability of medical knowledge.

After PIF-rCBCC, students began to seek as much authentic and applicable information as possible from learning materials in their daily self-study.

'When I study a text now, I began to think how the knowledge can be used for the patient.'
(Questionnaire, 2019-13)

'It's really important to learn about disease by studying the texts and the comprehensive knowledge, but since that tertiary material is insufficient for responding to clinical questions and individual patient backgrounds, I'm not sure that knowledge is useful in clinical practice. For that, what's most meaningful are secondary materials like UpToDate, or if you still have doubts then primary material research papers.' (Questionnaire, 2019-1)

After beginning to pursue authenticity and applicability of medical knowledge during their daily self-study, students found diversity and inconsistency in information from learning materials. To deal with this, they began to formulate inquiries focusing more on self-study, a variety of information resources, and different viewpoints. Through this strategic shift, critical thinking emerged in an intrinsic manner.

'I've come to think opinions are going to diverge to some extent as you get down to actually asking opinions of several different doctors, and these are choices you have to make, the stages you go through when studying.' (Interview, 1C-7)

'Having the ability to doubt, and because it's science not taking everything at face value, becoming skeptical, I think that's necessary.' (Interview, 3C-14)

'Now I try not to depend on only one research paper to know something.' (Questionnaire, 2019-10)

Discussion

To our knowledge, this is the first study investigating effects of a concrete PIF-oriented education format on SRL in undergraduate medical education. We explored whether PIF-oriented education enhances SRL by formulating two research questions.

Regarding the first research question ‘Does PIF-rCBCC improve SRL better than the original format rCBCC?’, among original rCBCC subjects *intrinsic goal orientation* and some other MSLQ-J categories showed lower post-program values, while among PIF-rCBCC subjects values in most categories increased. This indicates work-based learning without PIF-oriented instruction is not effective as an educational approach for SRL with JMU medical students on short-term rural placement. On the other hand, significant improvement in *intrinsic goal orientation and critical thinking* in PIF-rCBCCs compared with original rCBCCs implies PIF education in future work settings may promote SRL.

The original format rCBCC had already fulfilled its first goal of training in future work settings with future role models. Therefore, the quantitative comparative approach in this study by design evaluated effects of the additional SRL-based components. However, we do not mean to demean importance of the first goal. For instance, we believe students would not be able to recognize their future professional responsibility nor be as intrinsically motivated solely from interactions with university-based instructors, as previous studies suggest [16,17,35].

The qualitative analysis supports MSLQ-J results. Pertaining to *intrinsic goal orientation*, the thematic analysis showed students’ recognition of their future professional ‘responsibility’ was key to fostering it. Also, recognition of professional responsibility led to improvement of *critical thinking* or critical evaluation of learning materials in order to pursue authenticity and applicability of information for professional task processes. The consistency between quantitative and qualitative data was notable for understanding outcomes of the PIF-oriented education on SRL, insofar similar results demonstrate construct validity for additional education in the rCBCC program.

There was no statistical significance in the difference between PIF- and original rCBCC regarding *elaboration* in MSLQ-J data. However, qualitative analysis illuminated that PIF-rCBCCs’ attention to professional task processes triggered a strategic shift from memorization to *elaboration* of knowledge in accordance with their future professional task processes. Reasons accounting for the discrepancy could be the number of participants and sensitivity of outcome measurement. Further research is needed to address these issues. However, discrepancies between qualitative and quantitative evaluation does not indicate a study failure [36]. By incorporating both quantitative and qualitative data from a constructivist paradigm [33, 36], we thought that this study meaningfully captured educational benefits of shifting toward more PIF-oriented strategies.

The link between PIF and motivational aspects of SRL could be explained by ‘identity-based motivation’ proposed by Oyserman [37] as ‘the readiness to engage in identity-congruent action and to use identity-congruent mindsets in making sense of the world.’ According to her theory, people are more likely to interpret difficult experiences by implying task importance when an accessible identity feels congruent with the task [38]. In the context of this study, the increasing professional identity as a ‘physician-to-be’ strengthens the perception of importance of engaging in challenges at the practice site and self-regulate their learning behaviors by using identity-congruent mindsets and making sense of future learning tasks.

Therefore, theoretically SRL in medical education should be linked more to identity formation of professional medical practitioners.

Since the current study tested the PIF-oriented education format in only one school year curriculum of one medical university, general applicability remains unclear. If introduced to other institutions, we suggest program directors first ask students to articulate their future images and norms of professionalism, then carefully select mentors in accordance with students' statements. This PIF-oriented education format helped students imagine their futures and observe professional behaviors of JMU alumni mentors in clinical clerkships. Accordingly, students paid more attention to learning behaviors of their mentors. Therefore, teachers should recognize they are models not only for professionalism but also for self-regulated and life-long learners. To improve PIF-oriented SRL education quality, faculty development is essential [12, 13].

Strengths and limitations

The strength of this study is subjects were Japanese students considered to engage in less self-regulation than Western counterparts [10, 11, 20]. We believe our study can provide educators with evidence PIF-oriented educational schemes promote better learning behaviors in institutions struggling to promote undergraduates' SRL.

Another strength is there were few formal classes or training programs – i.e., intervening confounders – except for PIF-rCBCC or the original format rCBCC between pre and post data collection (Figure 2). We believed the study schedule without other educational interventions optimized learning comparison outcomes between the two groups.

This study has some limitations. First, we did not measure students' PIF levels before and after the PIF-oriented education. Therefore, we cannot fully attribute higher *intrinsic goal orientation* and *critical thinking* in quantitative data to better professional identity levels. However, qualitative data supported their medical practitioner professional identity formed with strong perceptions of 'responsibility'. These results suggest construct validity of the educational experience.

Second, we did not investigate alumni mentor perceptions regarding this PIF-oriented education format and Google Forms usability. According to comments, both students and doctors enjoyed opportunities for interactive communication. However, future studies need focus on mentor perceptions to ensure significance of the PIF-oriented education format.

Third, we have not followed long-term outcomes of PIF or SRL regarding self-study and clinical outcomes. According to previous studies [16, 38], identity is flexibly attuned to immediate situations rather than fixed in memory. Plus, frequently and fluently cued identities form into stable ones. Therefore, we predict repetitive PIF-oriented education could strengthen learners' SRL.

Conclusions

Allowing for these limitations and need for further research, this study indicated future work setting-based PIF-oriented undergraduate clinical clerkships with alumni mentors increased immediate *intrinsic goal orientation* and promoted shift to SRL. Their SRL was characterized as task process-based *elaboration*, with *critical thinking* emerging from pursuit of authenticity and knowledge applicability in medical practice.

Abbreviations

SRL: Self-regulated learning; PIF: Professional identity formation; MSLQ: Motivated Strategies for Learning Questionnaire; rCBCC: Rural community-based clinical clerkship; PIE: Professional identity essay

Declarations

Ethics approval and consent to participate

The study was approved by Jichi Medical University Clinical Research Ethics Committee (reference number: 19-001). Informed consent was obtained from all participants. The same statement is written in the end of the Introduction section.

Consent for publication

Informed consent was obtained from all participants for publication. All the authors have approved this publication.

Availability of data and materials

Google Forms format used in PIF-rCBCC is included within Add. File 1. The guide for attending JMU postgraduates participating in PIF-rCBCC is included within Add. File 2. Items used in the questionnaire and the interview form for PIF-rCBCC participants are included within Add. File 3. The all datasets analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors report no conflicts of interest.

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Authors' contributions

YM, KK, JL, and CV substantially contributed to conception and research design. YM, SI, KK, and YA substantially contributed to data collection. YM and JL substantially contributed to statistical analysis for quantitative data. YM and HO contributed to initial data coding. YM and AJL contributed to Japanese-

English translation of data collection tools (MSLQ and PIE) and qualitative data from questionnaire and interviews. YM, HO, JL, and CV substantially contributed to qualitative analysis. YM wrote the manuscript together with JL, and CV. YM, AJL, JL, and CV contributed to manuscript proofreading.

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Tables

Table 1. Pre-program Motivated Strategies for Learning Questionnaire-J fifteen category scores and descriptive gender and academic rank data

		PIF-rCBCCs	Original rCBCCs	<i>p</i> value
		(N=41)	(N=41)	
Gender	Male/Female	30/11	30/11	
Academic rank in the previous school year	Mean ± SD	43.7 ± 33.0	45.3 ± 32.4	0.79
	Median	36	37	
1. Intrinsic goal orientation	Mean ± SD	4.07 ± 1.18	4.23 ± 1.16	0.42
	Median	4.00	4.25	
2. Extrinsic goal orientation	Mean ± SD	3.67 ± 1.46	3.69 ± 1.44	0.95
	Median	3.75	3.75	
3. Task value	Mean ± SD	5.12 ± 0.95	4.85 ± 1.17	0.34
	Median	5.33	4.83	
4. Control beliefs	Mean ± SD	4.92 ± 0.92	4.69 ± 0.98	0.09
	Median	4.75	4.50	
5. Self-efficacy	Mean ± SD	3.52 ± 1.11	3.36 ± 1.23	0.72
	Median	3.38	3.50	
6. Test anxiety	Mean ± SD	3.94 ± 1.17	4.35 ± 1.03	0.12
	Median	4.20	4.40	
7. Rehearsal	Mean ± SD	4.38 ± 1.07	4.23 ± 0.91	0.81
	Median	4.25	4.25	
8. Elaboration	Mean ± SD	4.46 ± 1.00	4.32 ± 1.13	0.86
	Median	4.50	4.50	
9. Organization	Mean ± SD	4.45 ± 1.35	4.27 ± 1.30	0.66
	Median	4.50	4.50	
10. Critical thinking	Mean ± SD	4.11 ± 1.10	4.30 ± 1.21	0.36
	Median	4.20	4.40	
11. Metacognitive regulation	Mean ± SD	4.23 ± 0.70	4.18 ± 0.82	0.89
	Median	4.25	4.17	
12. Time and environment	Mean ± SD	4.63 ± 0.85	4.44 ± 0.87	0.38
	Median	4.50	4.25	
13. Effort management	Mean ± SD	3.92 ± 1.07	3.91 ± 0.96	0.83
	Median	4.00	4.00	
14. Peer learning	Mean ± SD	4.70 ± 1.24	4.40 ± 1.24	0.36
	Median	4.67	4.67	
15. Help seeking	Mean ± SD	4.46 ± 0.97	4.37 ± 0.96	0.34
	Median	4.50	4.25	

Table 2. Pre-post program difference Motivated Strategies for Learning Questionnaire- J fifteen category scores

		PIF-rCBCCs	Original rCBCCs	<i>p</i> value	ϵ^2 value
		(N=41)	(N=41)		
1. Intrinsic goal orientation	Mean \pm SD	0.48 \pm 1.02	-0.26 \pm 1.17	0.005	0.096
	Median	0.50	-0.25		
2. Extrinsic goal orientation	Mean \pm SD	0.31 \pm 1.36	-0.05 \pm 1.04	0.200	0.020
	Median	0.25	0.00		
3. Task value	Mean \pm SD	0.12 \pm 1.08	-0.02 \pm 1.08	0.587	0.004
	Median	0.00	0.00		
4. Control beliefs	Mean \pm SD	0.04 \pm 1.07	0.02 \pm 1.16	0.665	0.002
	Median	0.00	0.25		
5. Self-efficacy	Mean \pm SD	0.49 \pm 1.20	0.10 \pm 0.82	0.210	0.019
	Median	0.25	0.00		
6. Test anxiety	Mean \pm SD	0.30 \pm 1.07	-0.11 \pm 1.07	0.152	0.025
	Median	0.20	0.00		
7. Rehearsal	Mean \pm SD	0.23 \pm 1.23	-0.02 \pm 1.14	0.500	0.006
	Median	0.25	0.00		
8. Elaboration	Mean \pm SD	0.30 \pm 1.23	0.13 \pm 1.03	0.083	0.037
	Median	0.50	0.00		
9. Organization	Mean \pm SD	0.08 \pm 1.48	-0.04 \pm 1.08	0.915	<0.001
	Median	0.00	0.00		
10. Critical thinking	Mean \pm SD	0.48 \pm 1.08	-0.06 \pm 1.21	0.041	0.051
	Median	0.60	0.00		
11. Metacognitive regulation	Mean \pm SD	0.31 \pm 0.80	-0.07 \pm 0.69	0.060	0.043
	Median	0.16	0.00		
12. Time and environment	Mean \pm SD	0.02 \pm 1.28	0.02 \pm 1.03	0.700	0.002
	Median	0.00	0.00		
13. Effort management	Mean \pm SD	0.41 \pm 0.89	0.10 \pm 0.85	0.092	0.035
	Median	0.25	0.00		
14. Peer learning	Mean \pm SD	0.03 \pm 1.28	0.03 \pm 1.03	0.978	<0.001
	Median	0.00	0.00		
15. Help seeking	Mean \pm SD	0.04 \pm 1.27	0.04 \pm 0.84	0.819	<0.001
	Median	0.00	-0.25		

Figures

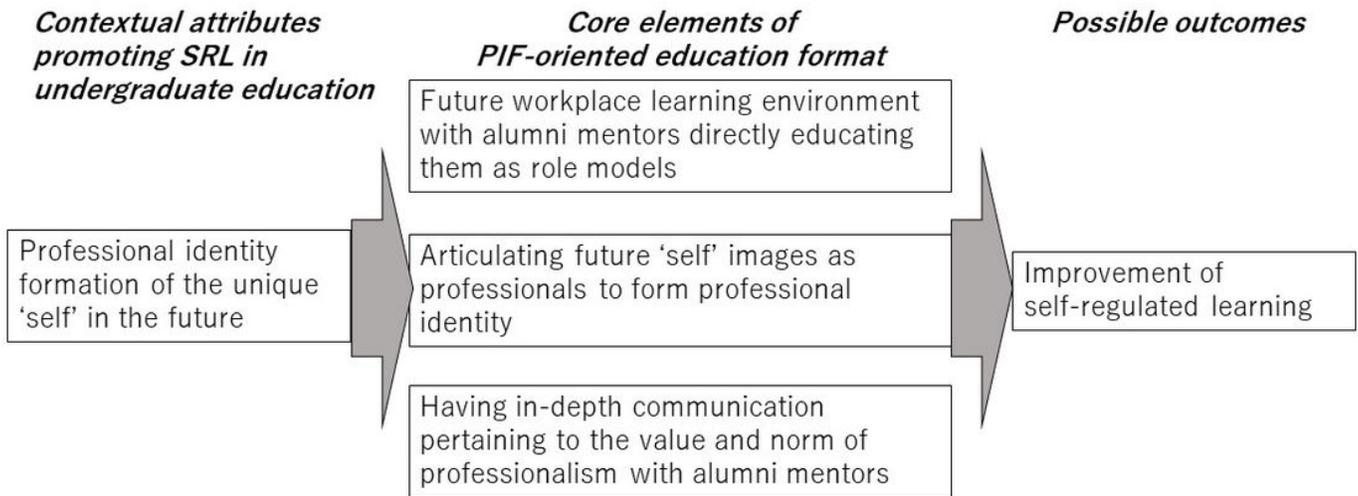


Figure 1

Conceptual framework for the PIF-oriented education format

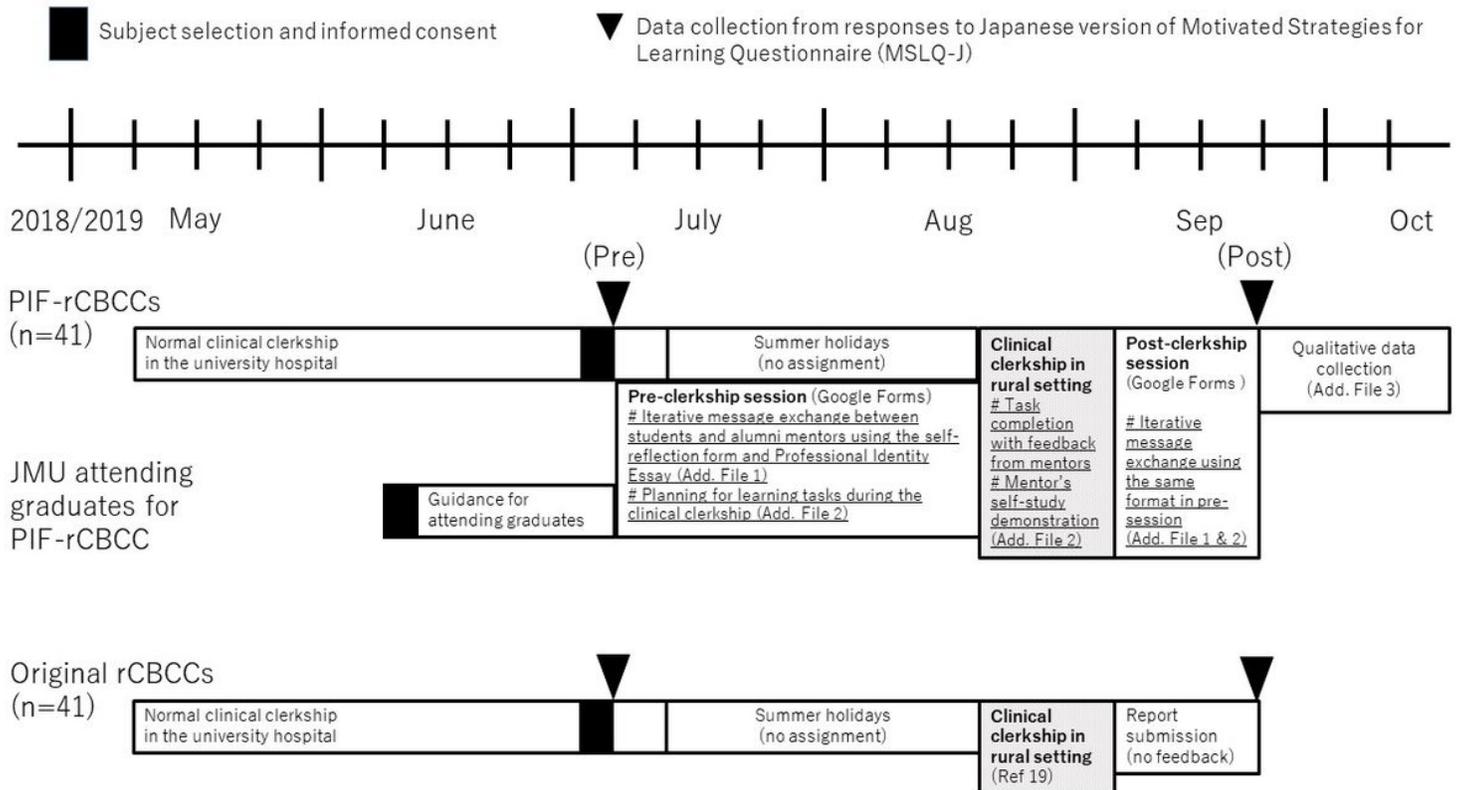


Figure 2

Schedule of the present study

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