

1 **Original article**

2 **Title:**

3 **Improved cognitive apprenticeship clinical teaching after faculty development**

4 **program**

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11

1 **Abstract**

2 **BACKGROUND:** While it is well known that the cognitive apprenticeship is an effective
3 workplace-based teaching approach for clinical teachers, the effects of faculty
4 development (FD) have not been analyzed from that perspective. The purpose of this
5 study was to investigate self-assessment by clinical teachers of their educational
6 perceptions and behaviors after FD using the cognitive apprenticeship model.

7 **METHODS:** Board-certified pediatricians who participated in a 3-day FD program on
8 practical clinical teaching were asked to complete the questionnaires. Fifty participants
9 completed two questionnaires prior to and 3 and 6 months after the FD program: the
10 first was on the participants' general perceptions and behaviors in relation to their own
11 clinical education and the second was a self-assessment using the Maastricht Clinical
12 Teaching Questionnaire (MCTQ) that developed based on the cognitive apprenticeship
13 model.

14 **RESULTS:** A general survey demonstrated that 78% of the participants experienced
15 positive changes in their educational perceptions 6 months after FD. Self-assessment
16 using the MCTQ showed that the scores in the categories of "articulation",

1 “exploration”, and “safe learning environment” remained significantly improved 6
2 months after the FD program.

3 CONCLUSION: The participants’ self-perceived improvement in behaviors was
4 sustainable for 6 months after the participation the FD program. The results of the MCTQ
5 show that through their experiences in the FD program, the participants seemingly
6 transformed their clinical teaching to become interactive facilitators encouraging self-
7 directed learning. Our results also suggest that the MCTQ can be used for self-assessment
8 of clinical teachers and to enhance the effectiveness of the FD program.

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1 Introduction

2 An increasing emphasis on competency-based training in medical education has led to
3 the reconsideration of, and changes in, the role of the clinical teacher ¹⁾. As the importance
4 of self-directed learning has been emphasized, effective clinical teachers are expected to
5 act as facilitators to enhance interaction with learners, rather than acting purely as
6 providers of knowledge ^{2) 3)}. Clinical teachers must be equipped with the appropriate
7 educational competency to provide effective learning opportunities, such as interactive
8 teaching and learning, to learners in the workplace, to ensure that they achieve the
9 specified outcomes ^{4) 5)}. Cognitive apprenticeship theory⁶⁾ is a key concept in modern
10 clinical education that emphasizes the facilitation of learning and interaction with learners
11 ⁷⁾.

12 Cognitive apprenticeship is defined as “learning through guided experience on
13 cognitive and metacognitive, rather than physical, skills and processes” ⁶⁾ and adapts the
14 traditional apprenticeship system which focused observation and increasing task
15 performance as a model of teaching. This model provides a framework that makes the
16 tacit educational process of teachers visible to learners and is based on six specific
17 teaching categories: “modeling”, “coaching”, “scaffolding”, “articulation”, “reflection”

1 and “exploration”⁶⁾. In the cognitive apprenticeship model, teaching and learning
2 emphasize is based on experts providing learners with self-directed learning of the
3 complex processes associated with task management and problem solving ⁸⁾⁹⁾. This model
4 has been described as being flexibly and effectively applicable to education in the rapidly
5 changing healthcare setting ^{7) 10)}. Evidence suggests that in clinical education, learners ¹¹⁾
6 ¹²⁾, including postgraduate residents ^{13) 14)} and faculty members ¹⁵⁾, are satisfied with
7 cognitive apprenticeship teaching and learning models.

8 Studies have indicated that the Maastricht Clinical Teaching Questionnaire (MCTQ)
9 ¹⁶⁾, which was developed based on the cognitive apprenticeship model, is a reliable, valid
10 and effective tool for the assessment of the teaching behaviors of clinical teachers by
11 learners ^{16) 17) 18) 19)}. The MCTQ covers four of the six categories of the cognitive
12 apprenticeship model: “modeling”, “coaching”, “articulation”, and “exploration”. It also
13 covers the establishment of a “safe learning environment” ²⁰⁾, which is emphasized in
14 clinical education. These five categories are divided into three steps: Step 1, facilitation
15 by teachers, which is described as a prerequisite for an effective teacher-learner
16 relationship: “modeling” *and* “safe learning environment”; Step 2, interaction between
17 learners and teachers: “coaching”; and Step 3, stimulating learners’ self-regulation:

1 “articulation” and “exploration”¹⁵⁾. The MCTQ was originally developed to provide
2 individual clinical teachers with feedback from learners concerning their teaching skills,
3 and the MCTQ is an even more effective feedback resource for clinical teachers when it
4 is combined with their reflections on the feedback from the learners¹⁷⁾.

5 Faculty development (FD)²¹⁾ for clinical teachers has been designed to help them adapt
6 to epistemological changes in clinical education²²⁾. Many medical institutions have
7 offered diverse FD programs to develop clinical teachers’ teaching skills²³⁾; however,
8 few studies have examined the long-term impact of FD on clinical education in medicine
9²¹⁾. Investigating the sustainability of changes the workplace-based teaching behaviors of
10 participants after FD should be regarded essential in clinical education. Only one case
11 study²⁴⁾ has examined whether clinical teachers regard the cognitive apprenticeship-
12 based FD as effective, and there has been no study of the sustainability of cognitive
13 apprenticeship after FD.

14 Our purpose was to investigate the impact of FD on clinical teaching for clinical
15 teachers in pediatrics (CTPs). Specifically, we aimed to examine the sustainability of the
16 impact of FD on CTPs. We also examined the changes in the self-perceived behaviors of

1 clinical teachers in their clinical teaching practice after participation in an FD program,
2 using the cognitive apprenticeship as a conceptual framework.

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4 **Methods**

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6 **Setting of the FD program**

7 This study used the FD program for CTPs designed by the Committee of Education of
8 the Japan Pediatric Society (JPS)²⁵⁾ which was launched in 2008. This program was
9 designed to use the effective modern educational model such as learner-centered
10 education, outcome-based education etc. to teach CTPs in a clinical setting, to help CTPs
11 acquire knowledge and skills, and to plan improvements in the pediatric training program.
12 It is a 16-h, 3-day program provided twice a year, and the number of participants in each
13 program is between 30 to 42. Emphasizing adult learning and learner-centered education,
14 the program uses active learning strategies, such as group discussions and reflection, role
15 play, and skills training (Table 1). In each session, pediatric cases are used to facilitate
16 understanding of the core concepts and the transferability of knowledge, skills and
17 approaches to clinical settings. All participants in this study were JPS-certified board

1 pediatricians from teaching hospitals in Japan with more than 7 years of clinical
2 experience. Eighteen facilitators, including 13 graduates (72%) of this FD program and
3 five female facilitators (28%), planned and ran this FD program. The average age of the
4 facilitators and their average years of experience as a physician were 46.5 years and 21.5
5 years, respectively.

6

7 **Participants**

8 In 2014 and 2015, 114 participants in the FD program were asked to respond to
9 questionnaire surveys to evaluate their clinical teaching. Questionnaire prior to FD were
10 administered in person on the first day of FD, and follow-up questionnaires were
11 administered by mail 3 months and 6 months after FD. The response rates to the
12 questionnaires prior to, 3 months after, and 6 months after FD were 94%, 64%, and 60%,
13 respectively. We analyzed responses from 50 (46%) participants from 43 teaching
14 hospitals who completed all questionnaires. There were 15 female participants (30%).
15 The average age of the participants and their years of experience as a physician were 43.0
16 (range 33-61) and 17.1 years, respectively.

17

1 **Instruments**

2 Two surveys were conducted: a general survey and the MCTQ. To examine the overall
3 impact of FD, the general survey asked participants about the favorability, usefulness,
4 and transferability of the FD program to their teaching place 3 months after FD. It also
5 asked for a self-assessment of their behaviors in clinical teaching using a 5-point Likert
6 scale (5: strongly agree, 1: strongly disagree) 3 and 6 months after FD (Table 2). To
7 analyze specific changes in the CTPs, the MCTQ^{16) 17)} with a 5-point Likert scale
8 investigated the participants' self-assessment of their perceptions and behaviors in
9 relation to clinical education prior to, 3 months after, and 6 months after FD. The MCTQ
10 consists of 14 items classified in the five categories, "modeling", "coaching",
11 "articulation", "exploration", and "safe learning environment" (Table 3). Alpha-
12 coefficients for all factors of the original English version of MCTQ showed high internal
13 consistency (0.83-0.96)¹⁶⁾. The MCTQ was translated into Japanese through a back-
14 translation process that included the original author²⁶⁾. The alpha coefficients of Japanese
15 version were 0.64, 0.77, 0.82, 0.81, and 0.81, for "modeling", "coaching", "articulation",
16 "exploration", and "safe learning environment", respectively.

17

1 **Ethical considerations**

2 Ethical approval for this study was obtained from the Research Ethics Committee of the
3 Gifu University Graduate School of Medicine (Approval number 26-67). Written
4 informed consent was obtained from all participants.

5

6 **Statistical analyses**

7 R version 3.3.2 (R Foundation for Statistical Computing, Vienna, Austria) ²⁷⁾ was used
8 for statistical analyses. The Friedman test was used to compare the MCTQ results across
9 more than two groups (before FD and 3 and 6 months after FD), and the Wilcoxon signed
10 ranked test with Bonferroni correction was used for comparisons between two groups
11 before FD and 3 and 6 months after FD. Significance was defined as $p < 0.05$.

12

13 **Results**

14

15 **Overall impact of FD 3 and 6 months after the FD program**

1 The results of the general survey demonstrated that 94%, 92%, and 88% of the
2 participants rated the favorability, usefulness, and transferability of FD 3 months after the
3 program at either 5 (strongly agree) or 4 (agree). Moreover, 74% and 78% of the
4 participants reported that their perceptions of clinical education had changed in a positive
5 way (either strongly agree or agree) 3 and 6 months after FD, respectively. Sixty-two
6 percent and 56% of the participants reported that they had experienced positive changes
7 in their self-assessment of their behaviors in clinical teaching 3 and 6 months after FD,
8 respectively (Table 2). No significant difference in the self-assessment scores of
9 participants' perceptions and behaviors was identified 3 and 6 months after FD.

10

11 **Self-assessment using the MCTQ of specific changes in perceptions and behaviors**
12 **in clinical teaching**

13 Table 3 shows the results of the participants' self-assessment of their clinical teaching
14 prior to, 3 months, and 6 months after FD using the MCTQ.

15 The results of the MCTQ revealed that the difference in the score subtotal for
16 "modeling" was not significantly increased after FD compared to the score prior to FD
17 (Friedman test, $p=0.161$). Similarly, there were no significant differences before and 3

1 and 6 months after FD in the three individual item scores for “modeling”. The score for
2 item 2, “I create sufficient opportunity for the residents to observe me”, was slightly lower
3 than those for items 1 (demonstration) and 3 (role model).

4 The subtotal score for “coaching” was significantly increased 3 and 6 months after
5 FD (Friedman test, $p=0.006$). There was a positive change in the three individual item
6 scores for “coaching” after 3 and 6 months, although there was a significant change for
7 only item 5, “I adjusted my teaching level based on the experience of the residents”. The
8 scores for “coaching” and item 5 were the highest among the five categories and the 14
9 items at all time points.

10 The subtotal scores for “articulation” and for all three individual items were
11 significantly increased after 3 and 6 months compared to the scores obtained before FD.
12 The scores for item 9, “I stimulate residents to explore their strengths and weaknesses”,
13 were the lowest among those for the 14 individual items at each time point.

14 The subtotal scores for “exploration” and for the two individual items were also
15 significantly increased 3 and 6 months after FD. The increase in scores for item 11, “I
16 encourage residents to formulate learning goals”, from 2.94 before FD to 3.54 after 3
17 months and 3.46 after 6 months, was the greatest among the 14 items.

1 The subtotal scores for “*safe learning environment*” and for two of the three
2 individual items were also significantly increased.

3 When we compared the five subtotal scores, the scores for “articulation” and
4 “exploration” were significantly lower (#, $p < 0.01$) than those for “modeling”, “coaching”
5 and “safe learning environment” before FD, however the difference became negligible 3
6 and 6 months after FD.

7

8 **Discussion**

9 This is the first study to clarify statistically the sustainability of improved perception and
10 behavioral self-assessment of CTPs for their own clinical education after FD, using
11 MCTQ ¹⁶⁾ which was developed based on the conceptual framework of the cognitive
12 apprenticeship model. In accordance with our research questions, we discussed the
13 following three aspects: (i) sustained effect of FD from the perspectives of situated
14 learning and community of practice, (ii) change of perceptions for individual concepts of
15 the cognitive apprenticeship, and (iii) comparison of the utility of the self-assessment by
16 general survey and MCTQ.

1

2 **Sustainable effect of FD from the perspectives of situated learning and community**
3 **of practice**

4 This study suggested that our FD program had a sustainable impact on CTPs. This may
5 be due to the fact that the common context, situation and thoughts of the participants in
6 our FD might impact and facilitate the overall change after the program. Both participants
7 and facilitators in our FD program have a common background as pediatricians and have
8 a common role and responsibility as clinical teachers, which should have contributed to
9 making FD more effective. Two theoretical perspectives, --situated learning theory²⁸⁾ and
10 community of practice ²⁹⁾,--explain this effectiveness.

11 First, situated learning ²⁸⁾ in our FD for CTPs might have promoted the
12 understanding and application of the program to the real teaching setting afterward. In
13 situated learning theory, learning is enhanced when learners' interaction is activated, and
14 their pre-existing knowledge is combined with new learning in a specific situation. When
15 knowledge is tightly bound to a certain situation, it is easily applied to similar situations
16 ²⁸⁾. The longitudinal positive effectiveness of FD for 6 months is a result of the utilization
17 in our FD of various cases and materials specific to pediatrics, which could situate the

1 participants in a “real” clinical education setting, facilitate the transfer of learning to
2 practice, and make it easy to maintain learning in long-term memory.

3 Second, the fact that the participants shared a common specialty may have produced
4 a sense of belonging ²⁹⁾³⁰⁾ to the community of practice ³¹⁾ in the FD program. O’Sullivan
5 et al. ³²⁾ indicates that the social connections among all participants during an FD
6 influence the success of the program. Common experience and expertise among
7 participants and facilitators as pediatricians would create a relaxed atmosphere, facilitate
8 understanding, cooperative learning and active discussion, as well as foster a sense of
9 belonging to the same community. Creating an educational culture that supports the
10 professional development of clinical teachers requires institutional or organizational
11 leadership and support, adequate FD, and educational resources and planning ³³⁾. The
12 results of this study suggest that medical specialties, as a community of practice, play an
13 important role in supporting the collaborative development of competency among clinical
14 teachers. Further study on the impact of matching the specialty of facilitators and
15 participants and the use of specialty-specific learning materials is necessary.

16

17 **Change of perceptions for individual concepts of the cognitive apprenticeship**

1 Perceptions of “articulation” and “exploration”

2 The participants’ self-assessment scores for “articulation” and “exploration”, which were
3 classified as the final step of stimulating student self-regulation ¹²⁾, were lower than the
4 scores for the other factors, such as “modeling” and “coaching”, before participation in
5 FD, but the scores increased markedly afterwards. These results suggest that our FD for
6 CTPs improved teachers’ perception of their ability “to stimulate learners’ self-
7 regulation”. Low scores for “articulation” and “exploration” before FD may be due to the
8 influence of the traditional apprenticeship method of teaching and learning that still exists
9 in clinical education. “Articulation” and “exploration” require clinical teachers to focus
10 on careful observation of learners and encouragement of learners’ autonomy, and these
11 ideas are not emphasized in traditional education. Therefore, participants who had been
12 educated in the traditional manner may not have sufficiently recognized the importance
13 of “articulation” and “exploration” before the FD program.

14 Our FD program aimed to increase the participants’ awareness of the importance
15 of promoting learners’ autonomy through topics such as goal setting, providing feedback,
16 and reflection (Table 1) through interactive experiential learning ³⁴⁾, which emphasizes
17 reflection after the learning experience. As a consequence of their learning experiences

1 in our FD program, the participants may have shifted their educational approach from the
2 traditional style to the modern facilitation method of “learning through guided experience”
3 ⁶⁾. Stalmaijer et al.¹⁵⁾, who developed the MCTQ, stated that cultivating the clinical
4 expertise of clinical teachers enables them to gradually learn to pay more attention to the
5 learning of learners and to move from Step 1, “modeling”, to Step 2, “coaching”, and Step
6 3, “articulation” and “exploration”. The significant increase in the scores for “articulation”
7 and “exploration” and partly for “coaching” observed several months after FD suggests
8 that the participants progressed to becoming mature CTPs who were conscious of Steps
9 2 and 3. Our study also implies that the periodic use of MCTQ will clarify strengths,
10 weaknesses, and the development of teaching competencies. Furthermore, the MCTQ
11 will offer a basis of educational strategies for behavioral change in clinical teachers in
12 various FD programs.

13

14 Perceptions of “safe learning environment”, “coaching”, and “modeling”

15 Among the categories “modeling”, “safe learning environment” (Step 1), and “coaching”
16 (Step 2) in the MCTQ, the scores for “safe learning environment” also showed a
17 significant improvement after FD. Our FD program offered the participants sufficient

1 time for skills training to provide adequate feedback and workplace-based assessments,
2 such as mini-clinical evaluation exercises ³⁵⁾ and direct observation of procedural skills
3 ³⁶⁾. These sessions emphasized the importance of respecting individual resident doctors
4 and creating a safe learning environment and atmosphere in which they can speak freely
5 to their teachers. The improvement in the scores for “safe learning environment” and
6 partly for “coaching”, which emphasizes interaction between learners and teachers,
7 suggests that the participants recognized the importance of respect for learners and
8 developed a learner-centered approach. In particular, the high scores for and improvement
9 in the item “I adjusted my teaching level based on the experience of the residents”
10 typically reflect the understanding of the need to individualize facilitation.

11 On the other hand, the scores of “modeling” did not change significantly after FD.
12 “Modeling” is likely to be a more familiar concept for traditional clinical teachers than
13 the other four concepts: “safe learning environment”, “coaching”, “articulation”, and
14 “exploration”. The participants seemingly already knew the importance of “modeling”
15 based on their past learning and teaching experiences. although the item “I create
16 sufficient opportunity for the residents to observe me” was perceived as less important
17 than other items.

1

2 **Comparison of the utility of the self-assessment by general survey and MCTQ**

3 This study utilized a general questionnaire and the MCTQ to investigate the effects of FD
4 on CTPs' perceptions and behaviors of clinical teaching. The general survey clarified the
5 positive changes of perceptions in CTPs, which were mainly the participants' subjective
6 general impressions, after FD. The MCTQ indicated that our FD had led the participants
7 to become mature CTPs who were equipped with a modern style of clinical teaching
8 based on cognitive apprenticeship ¹⁴⁾. By the participants' self-evaluation of their clinical
9 teaching from the viewpoint of the five categories of cognitive apprenticeship and 14
10 individual items, we were able to more specifically clarify the strengths and weaknesses
11 of the CTPs and the changes after the educational intervention. The MCTQ was originally
12 developed for learners to evaluate individual clinical teachers; however, our study
13 suggested that the MCTQ can also be used by clinical teachers to self-assess their
14 perceptions and behaviors in relation to cognitive apprenticeship. In addition, the MCTQ
15 can be useful in evaluating the strengths and weaknesses of FD programs by analyzing
16 the changes in the scores of participants after FD, thus reporting more details about the
17 participants. Therefore, it can contribute to the future development of clinical teaching

1 competencies and the reformation of FD programs.

2

3 **Limitations and future study**

4 Our study demonstrated that the MCTQ can be used as a self-assessment tool for
5 longitudinal changes in clinical teachers' perceptions and behaviors after participating in
6 an FD program. However, some limitations exist. First, we did not assess actual changes
7 in behavior of CTPs. In future research, actual behavioral changes should be investigated;
8 for example, learners' evaluation of the teachers should be compared with self-assessment
9 by teachers. Second, since we had no control group for comparison and analyzed data
10 from participants who responded to all questionnaires, the participants may represent an
11 interest group in clinical teaching, thus potentially biasing the results. Third, repeated
12 response to MCTQ might influence to self-assessment of clinical teaching by CTPs.
13 Finally, the alpha coefficient for "modeling" in the Japanese version of MCTQ was low
14 (0.64) compared to that of the original version. This may be related to the cultural or
15 contextual differences, (i.e., self-assessment by CTPs in our study vs assessment by
16 students in the original study). Further investigation is needed on the reliability of the
17 Japanese version.

1 **Conclusion**

2 This study clarified the improvement in the participants’ self-perceived clinical teaching
3 behaviors for at least 6 months after participation in the FD program for CTPs. The results
4 of the MCTQ suggest the enhancement of participants’ cognitive apprenticeship in
5 clinical teaching, especially in “articulation” and “exploration”, and the participants
6 seemingly shifted from traditional teachers to modern facilitators who encourage self-
7 directed learning. Our results also suggest the usefulness of the MCTQ for self-
8 assessment by clinical teachers and the evaluation of FD programs.

9

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13

14 **Declaration**

15 The authors declare no conflicts of interest.

16 **Consent for publication:** Not applicable

1 **Authors' contributions**

2 E.K. and Y.S. designed the study and wrote the initial draft of the manuscript. T.S. and
3 Y.S. contributed to the conception and design of the study and the analysis and
4 interpretation of data and assisted with the preparation of the manuscript. H.K. and K.N.
5 contributed to the acquisition of data. K.T. analyzed and interpreted the data. R.I. and
6 K.F. revised the manuscript critically for important intellectual content. All authors read
7 and approved the final manuscript.

8

9 **Data Availability Statement**

10 The datasets analyzed during the current study are available from the corresponding
11 author upon reasonable request.

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