A novel approach to improving colonoscopy learning efficiency through a colonoscope roaming system : randomized controlled trial

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Background. Colonoscopy is indispensable in the diagnosis and treatment of lower digestive tract (LDT) diseases. Skilled colonoscopists are in great demand, but it takes considerable time for beginners to become experts. In addition, patients may refuse to permit primary learners to practise colonoscopy on them. Thus, improving the instructional programmes and models for primary learners is a key issue in endoscopy training. Convenience and a self-paced, learner-centred approach make e-learning an excellent instructional prospect. Therefore, we created the Colonoscope Roaming System(CRS) to assist in colonoscopy teaching procedures. We aimed to develop the e-learning software, test it with beginner colonoscopists and evaluate its effectiveness via subjective and objective methods. **Methods.** Through a randomized controlled trial, participants were randomly allocated to an e-learning group (EG) or a control group (CG) after a pretest evaluation. The CG learned through the traditional colonoscopy teaching mode, while the EG used CRS in addition to the traditional teaching mode. Subsequent to the training, the participants completed a posttest and colonoscopy examination. The EG also completed a satisfaction questionnaire.**Results.** Of the 84 participants, 81 (96%) finished the colonoscopy learning and evaluation modules of the CRS. No conspicuous differences in the pretest scores were found between the EG and CG ($p>0.05$). Two months later, the posttest scores for the EG were higher than those of the CG ($p<0.001$), and the EG had better performance on the colonoscopy examination ($p<0.01$). Overall, 86.25% of questions raised in Q1-Q20 were satisfied with the CRS and considered it successful.**Conclusions.** The use of CRS may be an effective approach to educate beginner colonoscopists to attain skills.

A Novel Approach to Improving Colonoscopy Learning Efficiency Through a Colonoscope Roaming System: Randomized Controlled Trial

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Abstract

Background. Colonoscopy is indispensable in the diagnosis and treatment of lower digestive tract (LDT) diseases. Skilled colonoscopists are in great demand, but it takes considerable time for beginners to become experts. In addition, patients may refuse to permit primary learners to practise colonoscopy on them. Thus, improving the instructional programmes and models for primary learners is a key issue in endoscopy training. Convenience and a self-paced, learner-centred approach make e-learning an excellent instructional prospect. Therefore, we created the Colonoscope Roaming System(CRS) to assist in colonoscopy teaching procedures. We aimed to develop the e-learning software, test it with beginner colonoscopists and evaluate its effectiveness via subjective and objective methods.

Methods. Through a randomized controlled trial, participants were randomly allocated to an e-learning group (EG) or a control group (CG) after a pretest evaluation. The CG learned through the traditional colonoscopy teaching mode, while the EG used CRS in addition to the traditional teaching mode. Subsequent to the training, the participants completed a posttest and colonoscopy examination. The EG also completed a satisfaction questionnaire.

Results. Of the 84 participants, 81 (96%) finished the colonoscopy learning and evaluation modules of the CRS. No conspicuous differences in the pretest scores were found between the EG and CG ($p>0.05$). Two months later, the posttest scores for the EG were higher than those of the CG ($p<0.001$), and the EG had better performance on the colonoscopy examination ($p<0.01$). Overall, 86.25% of questions raised in Q1-Q20 were satisfied with the CRS and considered it successful.

40   **Conclusions.** The use of CRS may be an effective approach to educate beginner colonoscopists
41   to attain skills.
42

Background

44   Colonoscopy is a conventional and indispensable method for the diagnosis and treatment of
45   lower digestive tract (LDT) diseases. While the global demand for experts is enormous, the
46   endoscopy training process for beginners to gain mastery as specialists is lengthy *(Li et al.,*
47   *2020)*. This training was further complicated by the spread of coronavirus disease 2019 (COVID-
48   19), which disrupted traditional work, life and learning *(Okereke et al., 2020; Sawarkar,*
49   *Sawarkar & Kuchewar, 2020; Shrestha et al., 2020; Bączek et al., 2021; Baral & Baral, 2021;*
50   *Elsalem et al., 2021; Singh et al., 2021)*. Traditionally, experienced endoscopists have played an
51   important role in training primary learners, while the primary learners have worked with their
52   tutors to practice endoscopy on patients. It is common for primary learners to feel nervous and
53   anxious and to be unable to obtain satisfactory cooperation from their patients. Traditional
54   clinical training may fail to provide adequate information to meet learners' needs and
55   compensate for their cognitive deficits. Thus, improving the instructional programmes and
56   models for primary learners is key for successful endoscopy training.
57   Many researchers are studying e-learning applications in the field of medical education (Sait &
58   Tombs, 2021; Soundy et al., 2021; Su et al., 2021; Vedi & Dulloo, 2021; Oropesa et al., 2022).
59   The colonoscopy teaching model will inevitably develop in this direction due to digitization,
60   networking and intelligence (Feng et al., 2013; Longhini et al., 2021; Ouajdouni, Chafik &
61   Boubker, 2021). Thus, we created the Colonoscope Roaming System (CRS), an e-learning
62   system designed to assist in colonoscopy training.
63   Our objectives were to (1) develop a colonoscopy e-learning system for student learning,
64   (2) evaluate the system's effectiveness, and (3) promote the use of the software in medical
65   education.
66

Materials & Methods

68

Recruitment

70   We recruited participants in hospitals by posting notices about the experiment.
71   Inclusion criteria were as follows: (1) voluntarily participate in the study and sign the
72   informed document; (2) be able to complete gastroscopy independently without systematic study
73   of colonoscopy; (3) own computer that can support CRS operation and have basic computer
74   operation skills; and (4) complete the pretest questionnaire.
75   Exclusion criteria (those who met one of the criteria were excluded): (1) Quit during the
76   experiment or fail to complete the corresponding tasks as required; (2) The score of the pretest
77   was too high (the accuracy rate was higher than 80%) because the CRS was designed for
78   beginners who had not previously mastered colonoscopy knowledge *(Nakanishi et al., 2017)*.

79   The experiment was carried out from May 2020 to May 2021, with Figure 1 illustrating the flow.
80   Following the 30-minute pretest by the 84 eligible volunteers, elimination was performed based
81   on the exclusion criteria. IBM SPSS version 24 was employed to facilitate the random
82   assignment of the qualified participants into two groups: the e-learning group (EG) and the
83   control group (CG: non-e-learning). At the on-campus Endoscopy Centre of the Second
84   Affiliated Hospital of HMU, all enrolled students completed 2 months of theoretical and
85   practical training in colonoscopy. In the process, each EG participant received an account
86   number and corresponding password to facilitate logging into the CRS during the trial.
87   Following the training, the study subjects completed the posttest and colonoscopy examination
88   assessment two months later. The EG participants also completed a satisfaction questionnaire
89   regarding CRS. This study was approved by Harbin Medical University Institutional Research
90   Board (Approval Number HMUIRB2019008PRE). Participants gave written informed consent to
91   participate in the study.
92

Developing CRS and Its Description

94   We developed CRS in collaboration with Harbin University of Science and Technology.
95   The specific development process is shown in Figure 2. First, a 3-dimensional model   (Figure
96   3A-B) of the LDT was obtained after a review of various data sources (mostly photographs and
97   films of colonoscopy examinations from the Digestive Endoscopy Centre of the Second
98   Affiliated Hospital of Harbin Medical University [HMU]). The initial structure of the model was
99   created using Autodesk Maya software (Figure 3C-H), while the detailed structure of the colon
100 cavity was finalized with ZBrush software   (Figure 3I). The 3D model was then transformed
101 into an operating scene to simulate and render the physiological functions of the LDT.   Second,
102 the user interface of the system, including the log-in interface (Figure 4A), scene interface
103 (Figure 4B), exit interface, etc., was designed using Unity 3D software. The C# programming
104 language was used, giving the CRS the functions of interacting, cognition, and roaming (Figure
105 4C-G). CRS was built to be bilingual in Chinese and English and consists of two modes: focal
106 trigger mode (mode A) (Figure 4H) and structural exploration mode (mode B) (Figure 4I).
107

Learning Outcome Evaluation Strategy

109 In the 1950s, Kirkpatrick designed a well-known framework for the evaluation of learning
110 effects *(Giray, 2021)* that could be used to assess the effectiveness of the CRS *(Alliger & Janak,*
111 *1989; Ward et al., 2001; Galloway, 2005)*. The framework encompasses these 4 aspects of
112 assessment: reaction, learning, behaviour, and results *(Abdelhai et al., 2012)*.
113

Reaction Level Scoring

115 The reaction level was assessed through a satisfaction questionnaire. We used a questionnaire
116 developed by Wang, which has been widely cited in evaluations of e-learning satisfaction. This
117 questionnaire has been shown to have a reliability (Cronbach's alpha) of 95 *(Wang, 2003)*. Since
118 the current CRS does not contain the function of online mutual communication, the evaluation

119 section of the 'learning community' in the original questionnaire was removed in this
120 experiment. The 20 questions were divided into four modules: content satisfaction, interface
121 satisfaction, test satisfaction and personalized learning satisfaction. A 5-point Likert scale was
122 applied to score each question (strongly disagree 1, disagree 2, neutral 3, agree 4, strongly agree
123 5). The students' evaluation of each module and the overall evaluation were calculated. All EG
124 participants finished the satisfaction questionnaire after training completion. Because of the
125 COVID-19 pandemic and the paperless procedures, we created quick response (QR) codes for
126 the participants to answer the questions. The QR codes and the questionnaire are provided in
127 Supplemental File 1.
128

Assessing the Learning Level

130 The most routine and reasonable way to assess learning levels is to compare test scores before
131 and after the intervention. As mentioned above, the pretest was performed prior to colonoscopy
132 learning, and the posttest was performed following the 2 months of training. To ensure that the
133 pretest and posttest are of the same difficulty, both tests have the same questions, but the order of
134 the questions is different *(Oliveira, Mattos & Coimbra, 2017)*. All of the colonoscopy images
135 used in the questions were from the Department of Gastroenterology, the Second Affiliated
136 Hospital of HMU. The test was compiled by experts from our endoscopy centre. The QR codes
137 and the test (posttest version) are available in Supplemental File 2.
138

Behaviour Level

140 As routine colonoscopy training was provided to all participants, we assessed behavioural levels
141 by measuring participants' actual colonoscopy performance. All the patients participating in the
142 colonoscopy tests had made appointments for a general colonoscopy at the outpatient department
143 and had agreed to have their colonoscopies performed by beginner colonoscopists. All students
144 needed to perform 20 colonoscopies after completing the entire learning process. During the
145 procedures, the instructor recorded the student's procedures, and the video was used to assess the
146 following: (1) the times to pass through the LDT and to reach the sigmoid colon, splenic flexure,
147 hepatic flexure and cecum; (2) the overall colonoscopy examination time and fluency; (3) the
148 clarity of the collected images; (4) diagnostic accuracy; (5) the patient's comfort and satisfaction;
149 and (6) the detection rate of colonic polyps. After three failed attempts in the above procedures,
150 the expert endoscopists performed the procedures and recorded it as a failure for the student
151 *(Cass et al., 1993)*. The entire operation process of the trainees was video-recorded. Each
152 participant had an opportunity to select the performance that he or she thought was the most
153 satisfactory for archiving. A total of 5 expert colonoscopists (from the Second Affiliated Hospital
154 of HMU) who were unaware of the participants' grouping scored the students' colonoscopy
155 examination videos based on their experience in colonoscopy. The experts collaborated to
156 develop the examination standards. The mean score was obtained. The QR codes and the grading
157 table for colonoscopy examinations are provided in Supplemental File 3.
158

159 *Result Level Scoring*
160 To evaluate the results, we developed a course called 'Integrated Online and Offline Teaching of
161 Digestive Endoscopy Class' for the standardized training of residents at the Second Affiliated
162 Hospital of HMU. The course certificate is shown in Supplemental File 4.
163
164 *Statistical Analysis*
165 R Studio 3.6.3 was used for data analysis. Measurement data following a normal distribution are
166 described as the means and standard deviations; measurement data not following a normal
167 distribution are described as the medians and upper and lower quartiles. For measurement data
168 following a normal distribution that had homogeneous variance between groups, Student's t test
169 was employed for comparisons between the two groups. If data did not follow a normal
170 distribution or the variances between the two groups were not uniform, the comparison between
171 the groups was performed by using the nonparametric Wilcoxon rank sum test. Enumeration data
172 are described as the frequencies (%), and the $\chi 2$ test was used for intergroup comparisons. A *P*
173 value of < 0.05 was considered to be statistically significant.
174
175 **Results**
176
177 *Sample Description*
178 Of the 84 eligible students from the Second Affiliated Hospital of HMU, 2 participants were
179 excluded based on the exclusion criteria. One student secured >90% in the pretest, and another
180 did not complete the pretest. Eighty-two (97%) fit the inclusion criteria after completing the
181 pretest. Random assignment of all 82 participants was done to the EG and the CG on average. In
182 the EG, one dropped out during the training period. Therefore, there were 40 participants in the
183 EG and 41 participants in the CG. Both groups displayed similar baseline characteristics, as
184 depicted in Table 1.
185
186 *Analysing the Examination Scores*
187 The pretest and posttest scores in the EG group and the CG group were not normally distributed,
188 so they are represented as the medians and upper and lower quantiles. A nonparametric
189 Wilcoxon rank sum test was used to perform comparisons between the two groups. The pretest
190 score in the EG was 48 (48, 50) and increased to 83 (80, 86) on the posttest (*p*<0.0001). In
191 contrast, the pretest score in the CG was 50 (46, 50) and increased to 80 (76, 84) on the posttest
192 (*p*<0.0001). The results showed that there were no significant differences in the pretest scores
193 between the EG and CG (*p*>0.05). In addition, after 2 months of training, the posttest results of
194 the EG were better than those of the CG (*p*<0.001) (Figure 5A).
195   For the colonoscopy examination scores, a total of 800 colonoscopies were performed
196 among 40 students in the EG. There were 617, 559, 526 and 275 instances of successful passage
197 of the colonoscope through the sigmoid colon, splenic flexure, hepatic flexure and cecum,
198 respectively. In the CG, 41 students performed a total of 820 colonoscopies, among which there

199   were 587, 526, 491 and 229 successful instances of passage of the colonoscope through the
200   sigmoid colon, splenic flexure, hepatic flexure and cecum, respectively. There were statistically
201   significant differences in the number of successful instances of passage of the colonoscope
202   through the sigmoid colon, splenic flexure, hepatic flexure and cecum between the EG and the
203   CG, with the EG having a higher number of successful instances than the CG (Figure 5C). The
204   detection rates of colon polyps in the EG and CG were 66 (8.25%) and 38 (4.63%), respectively,
205   which was a significant difference ($p<0.01$) (Figure 5C). The detection rate of polyps in the EG
206   was higher than that in the CG. The numbers of correct diagnoses during colonoscopy in the EG
207   and CG were 620 (77.5%) and 581 (70.85%), respectively, which was a statistically significant
208   difference ($p<0.01$) (Figure 5C). The correct rate of disease diagnosis in the EG was higher than
209   that in the CG (Figure 5C). The colonoscopy training score of the students in the EG was 91 (89,
210   93) points and that of the CG was 89 (86, 90) points. The difference between the two groups was
211   statistically significant, with the EG having a higher score than the CG (Figure 5B). The time to
212   reach the sigmoid colon, splenic flexure, hepatic flexure and cecum in the EG and the CG were
213   determined, and the time to reach each segment of the colon was shorter in the EG (Figure 5D).
214   Table 2 summarizes the examination scores.
215
216

217   *User Satisfaction of the CRS*
218   The satisfaction levels are detailed in four areas. Regarding the content uality, 87% of questions
219   raised in Q1-Q5 demonstrated that the course was up-to-date, useful, and sufficient and fit their
220   needs (Figure 6A). Regarding the interface quality, 83% of questions raised in Q6-Q10 showed
221   that the students were in favour of the speed, stability and user-friendly approach with ease of
222   finding the necessary content (Figure 6B). Regarding the testing quality , 86.5% of questions
223   raised in Q11-Q15 reveled that the course testing was prompt, secure, fair and easy to complete
224   and understand (Figure 6C). Regarding the quality of personalization, 88.5% of questions raised
225   in Q16-Q20 claimed that the CRS facilitated personalized learning, controlled their learning
226   progress, selected what to learn, recorded their learning progress, and helped them learn the
227   necessary content (Figure 6D). Overall, 86.25% of questions raised in Q1-Q20 were satisfied
228   with the CRS and considered it successful.

229   To further validate students' feedback, we conducted a satisfaction survey with patients. Both
230   groups displayed similar baseline characteristics, as depicted in Table 3. All the patients in the e-
231   learning group participated in the satisfaction survey, which showed a high level of satisfaction
232   (Figure 7).
233
234

235   **Discussion**
236

237   *Principal Results*

238   To date, textbooks and other written materials are considered the most widely spread knowledge
239   in traditional colonoscopy training *(Trelease, 2016)*, but in the field of medical skill operations,
240   the traditional mode does not provide three-dimensional thinking of the digestive tract structure
241   and operational experience. In addition, the COVID-19 pandemic has necessitated mandatory e-
242   learning in medical education. In this study, we developed, evaluated and applied e-learning
243   software named the CRS during the COVID-19 pandemic. We developed the CRS for student
244   learning colonoscopy in collaboration with Harbin University of Science and Technology, with
245   the CRS being the first e-learning program for colonoscopy teaching. Furthermore, the CRS was
246   developed to be used in either Chinese or English; therefore, the system can facilitate
247   colonoscopy training in China and worldwide.

248   After two months of learning, the theoretical test scores of all the students significantly
249   increased, with an EG score greater than that of the CG ($p<0.001$) (Figure 5A). This shows that
250   CRS is more effective in improving theoretical knowledge. The success rate of EG was higher
251   than that of CG in the four key points of colonoscopy operation, namely, the sigmoid colon,
252   splenic curvature, hepatic flexure and cecum. CRS provides beginners with a highly simulated
253   virtual environment of LDT, enabling them to freely explore the structure of LDT and then fully
254   master it through repeated practice so that they can have a good understanding of the actual
255   operation and effectively improve the success rate of operation. In the endoscopic diagnosis and
256   the polyp detection rate, the EG was significantly higher than the CG ($p<0.01$), indicating that
257   the students had enriched their experience in disease identification by learning endoscopic
258   images of common LDT diseases embedded in CRS. We further submitted the operation videos
259   of the students to expert colonoscopists for scoring and found that the scores of EG were higher
260   than those of CG ($p<0.01$), which fully demonstrated that the success rate of colonoscopy
261   operation can be improved through CRS in a short period of time. It was verified that CRS
262   enabled beginners to learn colonoscopy better and faster after they fully mastered the anatomical
263   structure of LDT, theoretical knowledge and endoscopic manifestations of common diseases.

264   However, the CRS is not meant to be a complete colonoscopy training but a
265   complementary training. E-learning is not a substitute for traditional learning,   but an effective
266   supplement to be used in combination with traditional learning mode.

267   The results of the satisfaction questionnaire show that the overall satisfaction rate of the
268   students in the EG was very high (Figure 6). Based on Wang's questionnaire, we obtained
269   satisfaction information with each aspect of the training. In terms of interface quality (Figure
270   4B), the CRS's operating interface was considered complex and somewhat difficult to
271   understand. The reason may be that the software design uses 'Z/X' to represent inhalation and
272   inflation, respectively. In the process of the insertion and passage of the colonoscope through the
273   digestive tract, the intestinal cavity must be continuously inflated; otherwise, the colonoscope
274   cannot pass through. We upgraded and improved the software version based on feedback from
275   the trainees and added detailed instructions for the procedures.
276
277   ***Limitations***

278   First, the small sample size at a single institution affects the generalizability of the results. The
279   main reason for the current study design was that our CRS software was still in its initial stage.
280   In the future, we will integrate endoscopy examination and treatment to establish a complete
281   endoscopy e-learning teaching system. Residents should be promoted to this system through
282   standardized training. Second, during the evaluation of the actual colonoscopy procedures, there
283   was no way to ensure the same difficulty level among students because of the variations in the
284   LDT structure and the differences in pain tolerance in each patient.
285

Conclusions

287   This experiment shows that CRS, as a meaningful supplementary approach to colonoscopy
288   training, is valid. The e-learning program can help beginners master colonoscopy skills and
289   become familiar with the characteristics of LDT. User satisfaction with CRS was extremely high
290   among the participants in this study. In summary, the use of the CRS may be an effective method
291   to educate beginner colonoscopists to attain skills and recognize the symptoms of common LDT
292   diseases.
293

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388

Figure 1

Figure 1: Flow diagram showing the details of participant enrollment, randomization, and tests.

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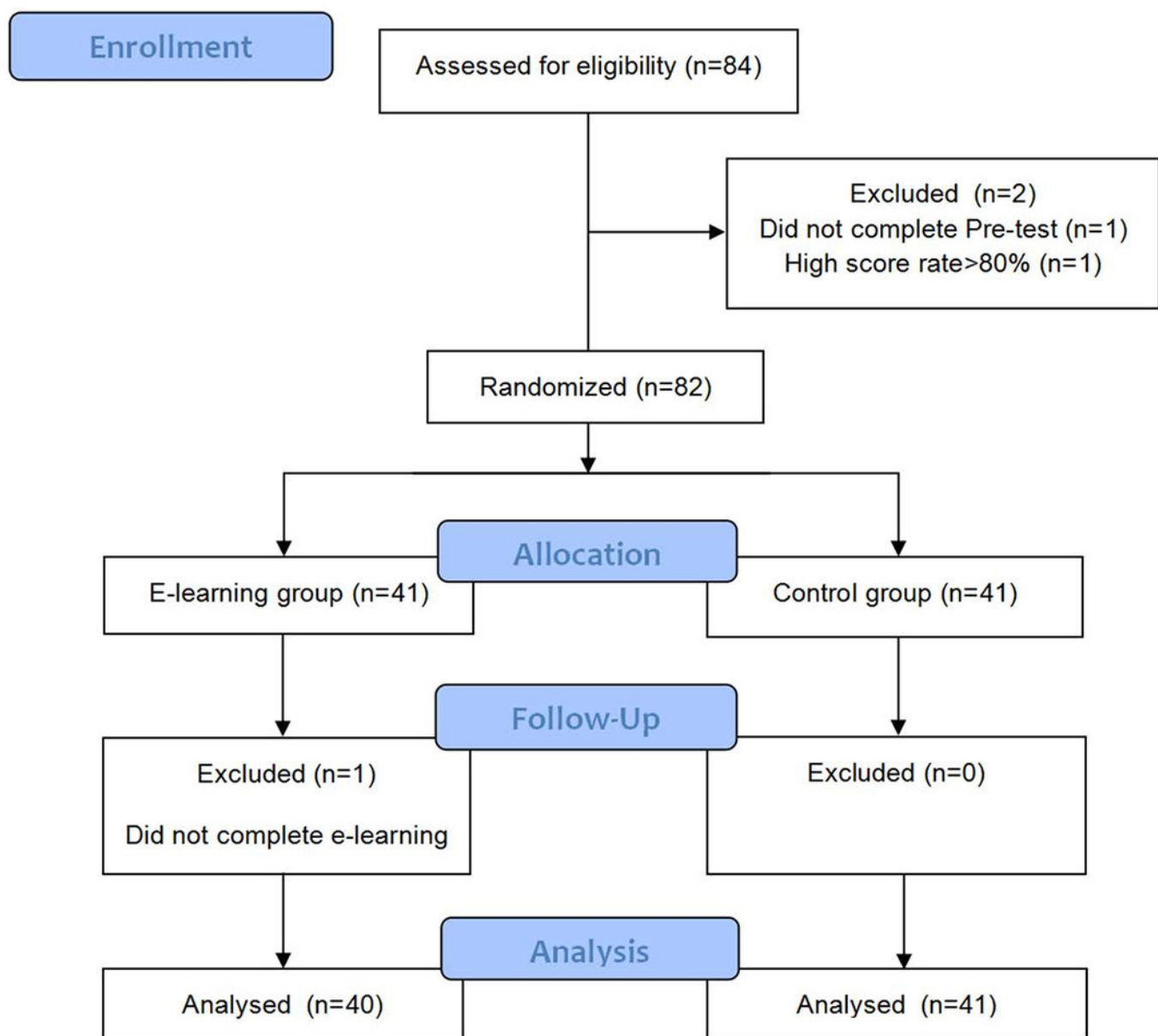
Figure 2

Figure 2: The software design process

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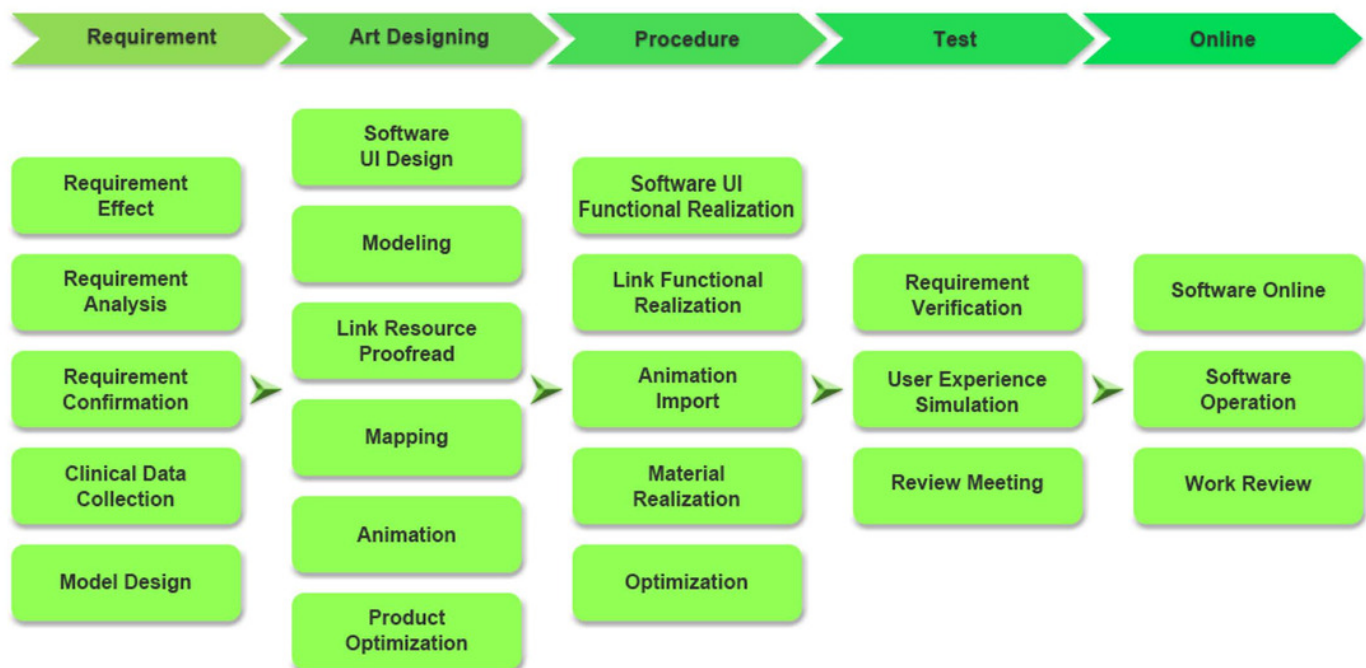
Figure 3

Figure 3: CRS software development of screen captures

Figure 3: CRS software development of screen captures: (A)-(B). 3-dimensional model. (C)-(H). Bake mapping technique from left to right for normal mapping, ambient occlusion, reflective mapping, gloss mapping and topology. (I). 3D model screenshot.
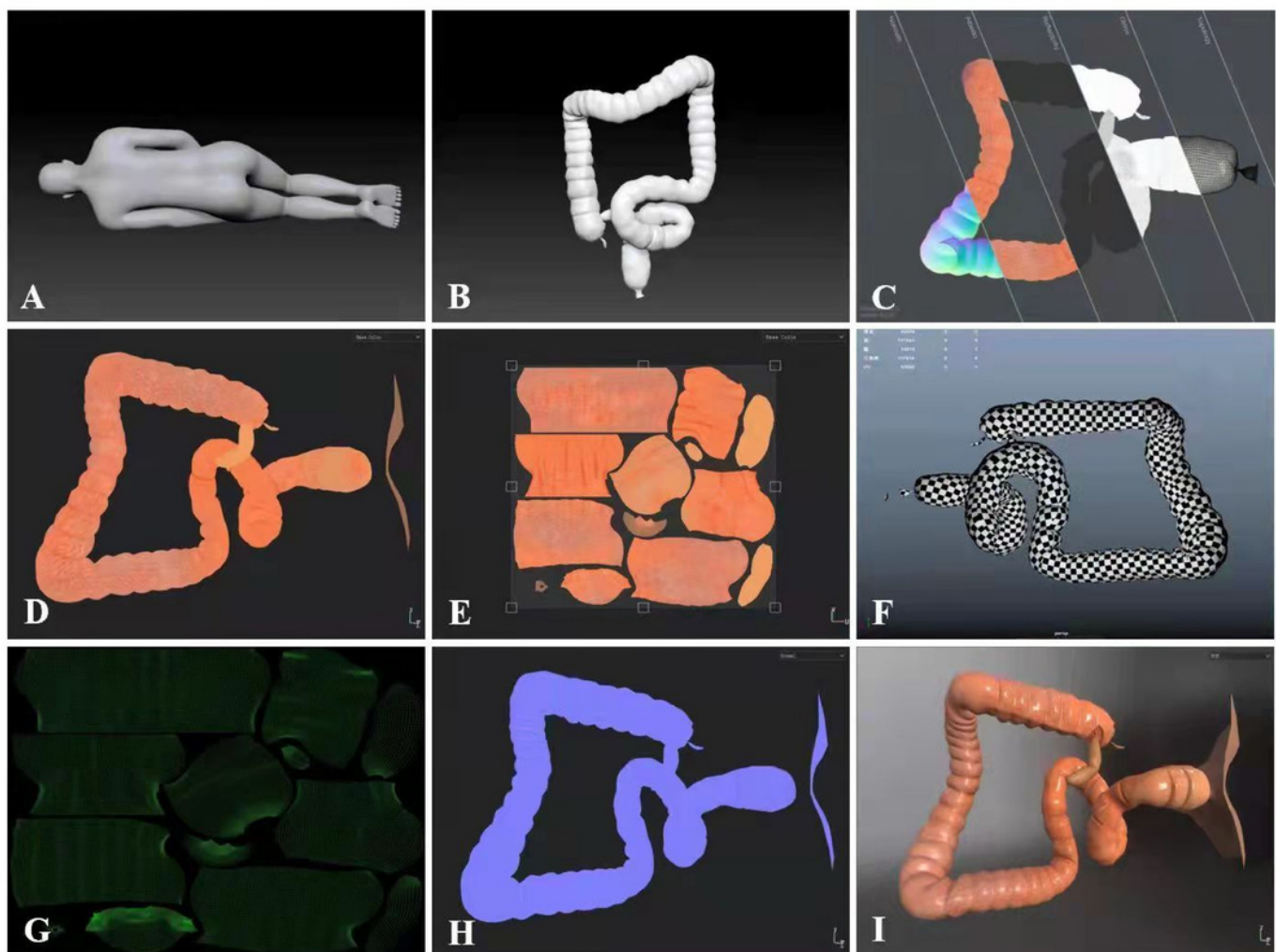
Figure 4

Figure 4: CRS software screen captures

Figure 4: CRS software screen captures: (A)Software system log-in interface in English. (B) Scene interface. (C) Software system log-in interface in Chinese. (D)-(I) Initial screen of the software.
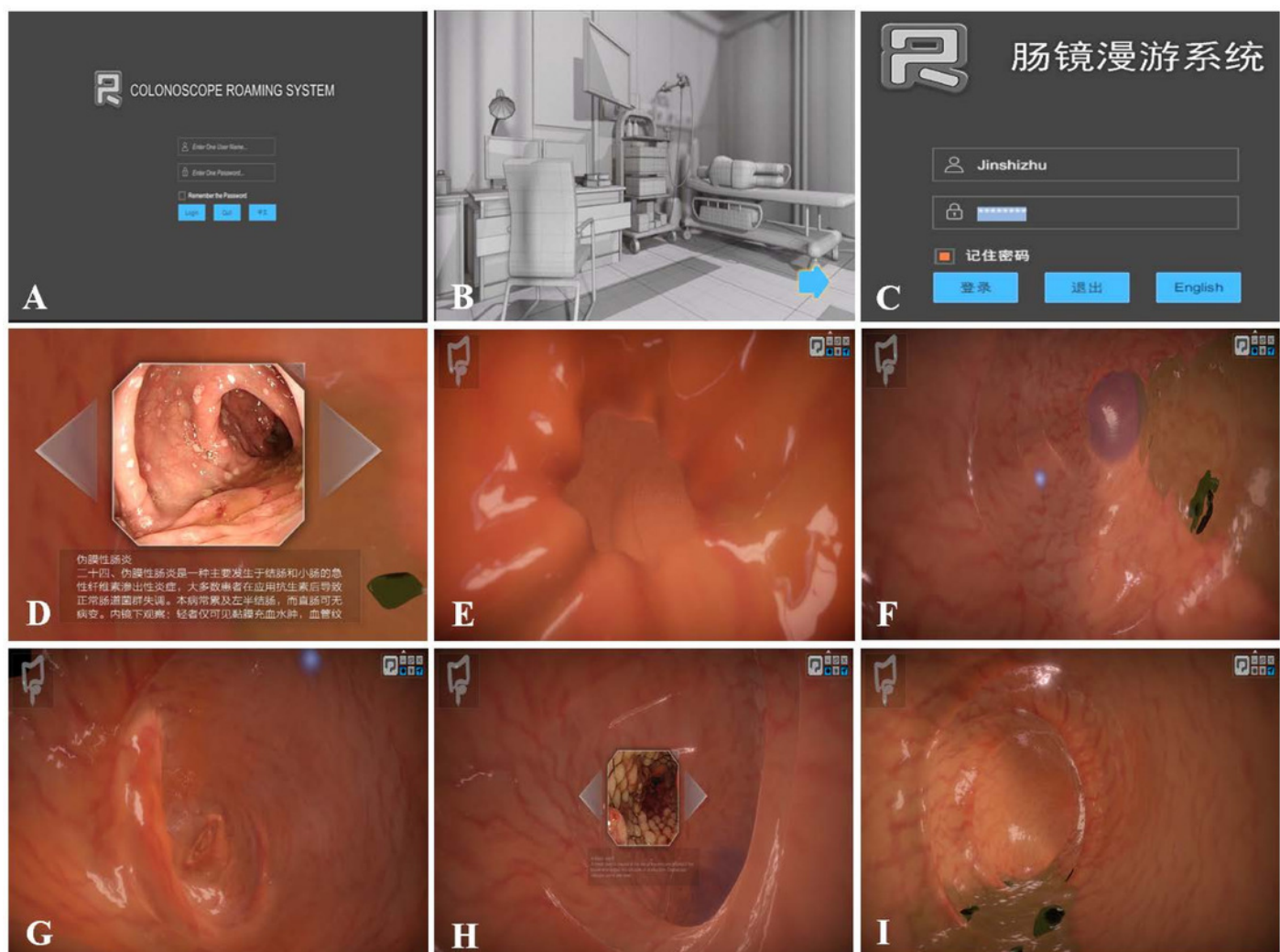
Figure 5

Figure 5: Learning and behavior level assessing

Figure 5: Learning and behavior level assessing. (A) Pretest and posttest scores of the e-learning group and control group. (B) Colonoscope examination results of the e-learning group and control group. **$p<0.01$. (C) The success rate of passage of the colonoscope through the sigmoid colon (SC), splenic flexure (SF), hepatic flexure (HF) and cecum (IV); polyp detection rate (PDR); and correct diagnosis rate (CDR). (D) The time period to reach each segment of the intestinal cavity in the EG and CG. ** $p <0.01$, *** $p <0.001$, **** $p <0.0001$.
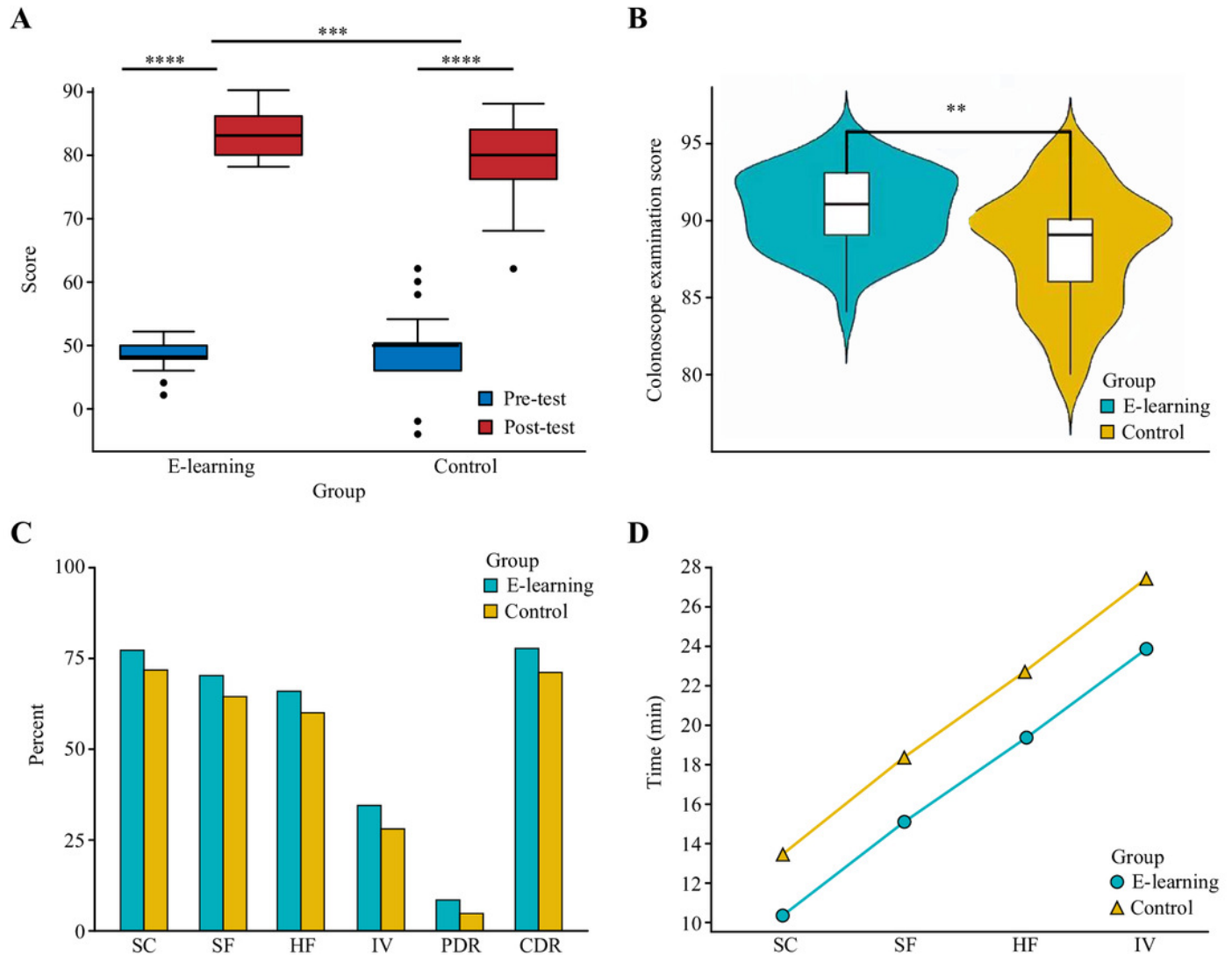
Figure 6

Figure 6: Analysis of the participants' satisfaction with the CRS in four areas.

Figure 6: Analysis of the participants' satisfaction with the CRS in four areas. (A) Content quality. (B) Interface quality. (C) Testing quality. (D) Personalization quality.
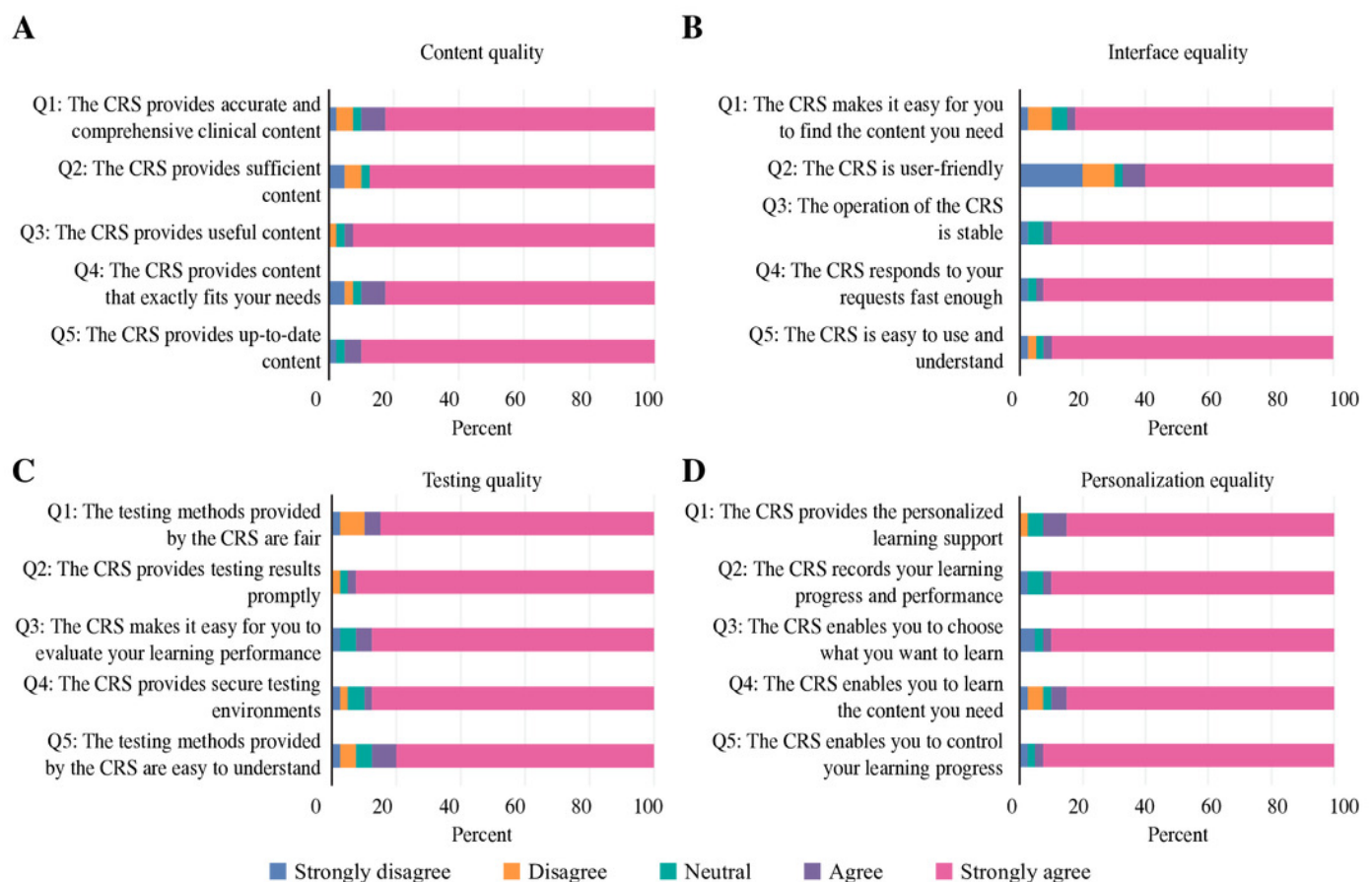
Figure 7

Figure 7: Analysis of the patient satisfaction questionnaire with the CRS in four areas. (A) Comfort level (CL). (B) Inform the process before examination (IPBE). (C) Notice of precautions after examination (NPAE). (D) Diagnostic levlel (DL).

Figure 7: Analysis of the patient satisfaction questionnaire with the CRS in four areas.
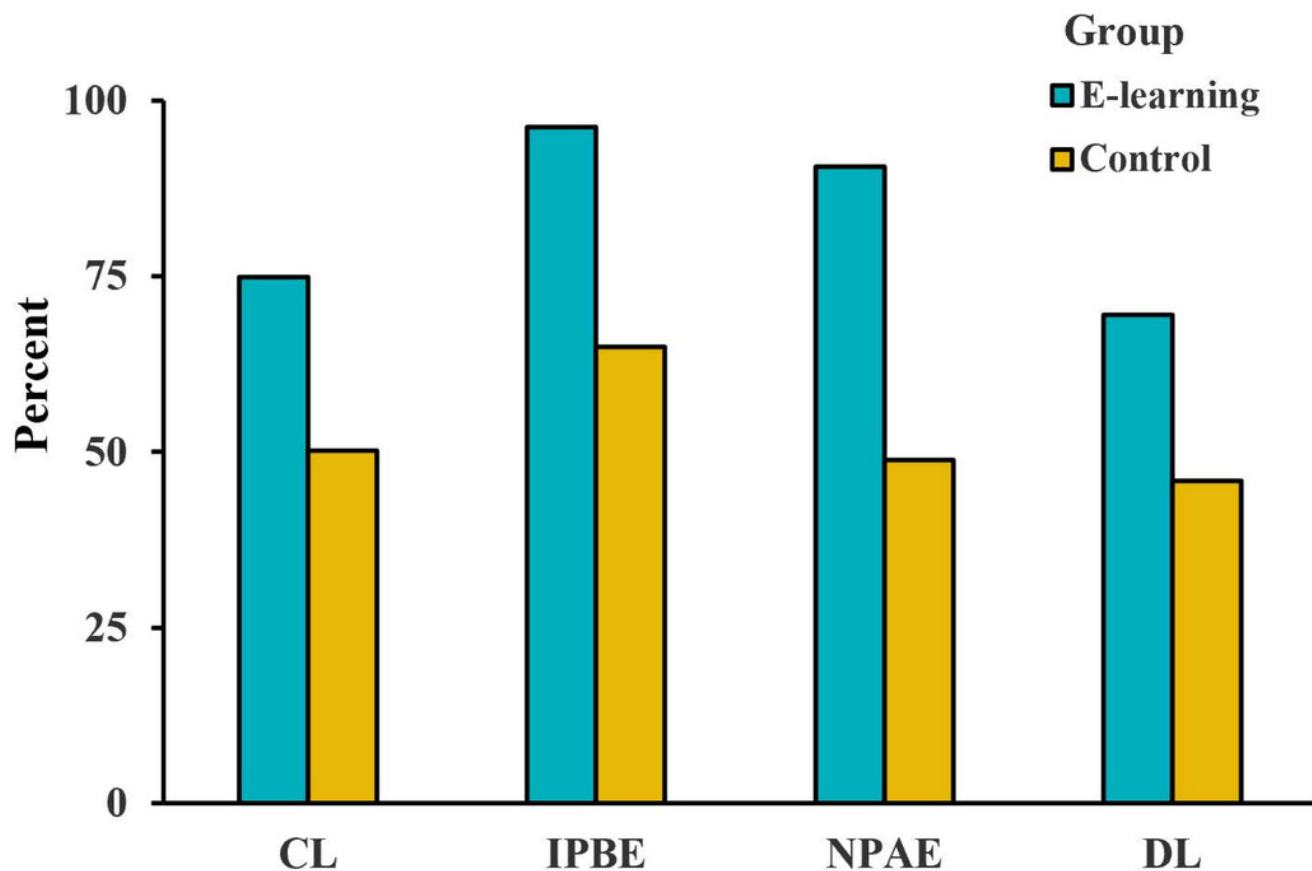
Table 1: Demographics and other characteristics of the participants.

1 **Table 1:**

2 **Demographics and other characteristics of the participants.**

Baseline characteristics	E-learning group (n = 40)	Control group (n = 41)	X^2/W	p value
Age (years)	25 (25, 25.25)	25 (25, 26)	751	0.4263
Gender, n (%)				
Male	14 (35%)	15 (36.59%)	0.0221	0.8817
Female	26 (65%)	26 (63.41%)		
Current year of residency training, n (%)				
Postgraduate year 1	6 (15%)	5 (12.20%)		
Postgraduate year 2	22 (55%)	24 (58.54%)	0.1656	0.9206
Postgraduate year 3	12 (30%)	12 (29.26%)		

Table 2: Examination scores.

1   **Table 2:**

2   **Examination scores.**

	E-learning group	Control group	X^2/t	p value
Sigmoid colon, n (%)				
Successful	617 (77.12%)	587 (71.59%)	6.5112	0.0107
Unsuccessful	183 (22.88%)	233 (28.41%)		
Splenic flexure, n (%)				
Successful	559 (69.87%)	526 (64.15%)	6.0082	0.0142
Unsuccessful	241 (30.13%)	294 (35.85%)		
Hepatic flexure, n (%)				
Successful	526 (65.75%)	491 (59.88%)	5.9751	0.0145
Unsuccessful	274 (34.25%)	329 (40.12%)		
Cecum, n (%)				
Successful	275 (34.38%)	229 (27.93%)	7.8559	0.0051
Unsuccessful	525 (65.62%)	591 (72.07%)		
Detection rate of polyps, n (%)				
Cases of polyps	66 (8.25%)	38 (4.63%)	8.8127	0.0030
None	734 (91.75%)	782 (95.37%)		
Instances of correct diagnosis, n (%)				
Correct	620 (77.50%)	581 (70.85%)	9.3288	0.0023
Incorrect	180 (22.50%)	239 (29.15%)		
Colonoscopy training score	91 (89, 93)	89 (86, 90)	1130	0.0033

Table 3: Demographics and other characteristics of the patients.

1 **Table 3:**

2 **Demographics and other characteristics of the patients.**

Baseline characteristics	E-learning group (n = 800)	Control group (n = 820)	X^2	p value
Age (years)	53(50,57)	53(50,56)	47.980	0.847
Gender, n (%)				
Male	411 (51.38%)	427 (52.07%)	0.0790	0.7786
Female	389 (48.62%)	393 (47.93%)		
History of abdominal operation				
Yes	357(44.63%)	368(44.88%)	0.0105	0.9184
No	443(55.37%)	452(55.12%)		