3. 講 演

クラーク 教授　南カリフォルニア大学

「VPを活用した臨床推論教育について」

Prof. Glenn Clark
University of Southern California

“How well does a Virtual Patient work to improve a students' clinical reasoning skills?”

この講演資料（PDF、ビデオ）は以下でご覧いただけます

昭和大学 歯学部 スペシャルニーズ口腔医学講座 歯学教育学部門 Web サイト
http://dedu.showa-u.ac.jp/project/report_ws_03.html

“Does a Virtual Patient experience improve students' clinical reasoning skills?

「仮想患者 (VP) で学習することで、臨床推論能力は向上するか？」

Glenn Clark, DDS, MS

Director, Advanced Program in
Orofacial Pain and Oral Medicine
Professor, Ostrow School of Dentistry of
University of Southern California

略歴

Dr. Clark is Professor in the Division of Diagnostic Sciences, Herman Ostrow School of Dentistry of USC. He is Director of the Center for Orofacial Pain and Oral Medicine and the Founding Graduate Program Director of the dual certificate residency program in Orofacial Pain and Oral Medicine at USC. Dr. Clark published over 145 research articles, review papers, and chapters in textbooks. He is Past-President of the Neuroscience Group of the International Association of Dental Research, the Southern California Association of Dental Research, and the Association of University Temporomandibular and Orofacial Pain programs. He is currently a member of the prestigious Council on Scientific Affairs of the American Dental Association. He has been awarded membership as a Diplomate of the American Board of Orofacial Pain (since 1996) and was voted alumnus of the Year of the UCLA School of Dentistry (1990). Dr. Clark was awarded the Pierre Robin Award for Academic Excellence (2001) by the Academy of Dental Sleep Medicine and the fellowship in the American Academy of Oral Medicine (2004). In 2006, he was given a lifetime achievement award by the American Academy of Orofacial Pain.

講演要旨

医学教育のトレンドとして患者シミュレーションについての論文発表は激増している。患者シミュレーションの目的は、初心者をエキスパートにするために教育を行う事である。クラーク教授は 1988 年に VP 教育を始めた(Clark GT, Koyano K, Nivichanov A. Case - based learning for orofacial pain and temporomandibular disorders. J Dent Educ.1993 Nov;57(11):815 - 20.)。コンピューター症例ベースシステムで顎関節症症例における 5 症例の試験点数は症例を重ねる毎に上昇した。2003 年に UCLA から USC に転勤した。2003 年の時点で、多くの医療系大学で VP を採用していた。クラーク教授は分岐型のアルゴリズムを用いた Web-based　VP システムを採用した。この第 2 世代システムで授業を行ったところ、VP 症例を完了させるまでの時間は症例を重ねると短縮したが、いわゆるマンネリ化して、あまり教育効果が見られなかった。そこで、第 3 世代の Virtual World - based VP System　すなわち 3 D 仮想現実内の 3 D 自律的 VP を開発した。この VP を用いて第 1 症例から第 4 症例学生と専門医における平均質問数を比較すると、第 4 症例では同一になった。しかし臨床推論の点数は専門医は 70%だったが、学生は 50%であった。臨床見学の前後における臨床推論の成績は、見学前の平均が 67%、見学後の平均が 76%と見学後有意に上昇していた。VP による学習は、医学部学生に、どのように新患の医療面接と診断を行うかを教育するのに有効か？という問に対しては、模擬患者と同等であると評価された。また VP が模擬患者よりも優れている場面はあるか？という問に対しては状況に応じて模擬患者より優れている場合もあると考えられた。また VP で様々な診察結果と検査結果を総合して、診断をつける課題で、学生に時間制限を設けると誤答率が高くなることが証明された。医療面接の結果から立てた仮診断をより確かなものにするために、検査を実施することは診断精度を向上させるかという問いに対しては、追加の検査結果が医療面接から推論した診断と一致しない場合に診断の精度を向上させるという結果が得られた。仮説の検証を繰り返すことが診断能力の向上につながるかという問いに対しては、PBL よりも効果的であるという結果が得られた。

VP を用いて学習することで、学生の臨床推論能力は向上するかという問いに対しては、臨床推論能力を向上させるという結果が得られた。将来的にはこの訓練が、医療過誤の減少、医療費の削減、医療職種の教育費削減に効果がある事を期待している。

The End! Thank you & remember

“The future is ours to create!”

クラーク教授の講演ビデオは以下でご覧になれます。

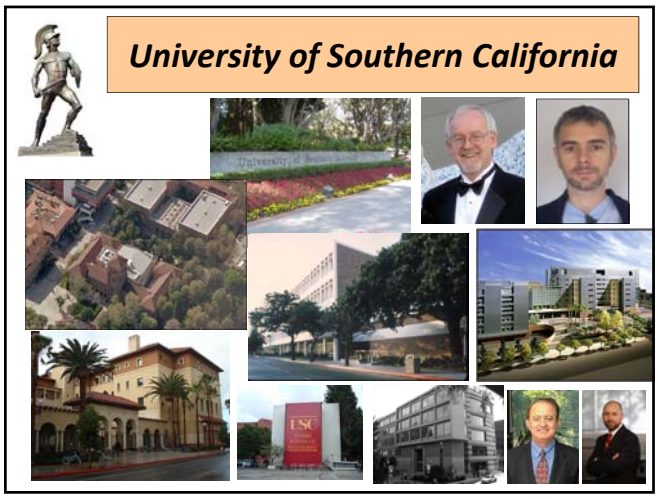
http://dedu.showa-u.ac.jp/project/report_ws_03.html

"Does a Virtual Patient experience improve students' clinical reasoning skills?"

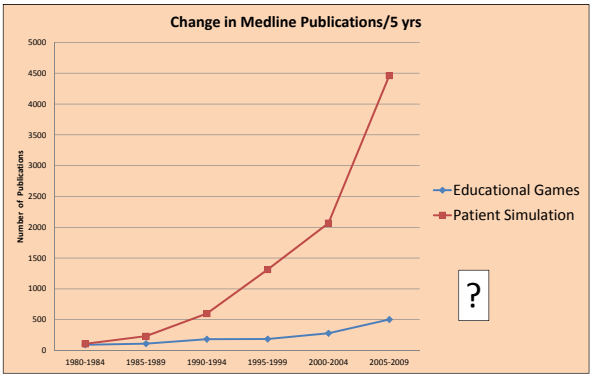
Dr. Glenn Clark
Dr. Luciano Nocera
Ostrow School of Dentistry
Univ. Southern Calif. [USC]

仮想患者（VP）で学習することで、学生の臨床推論能力は向上するか？

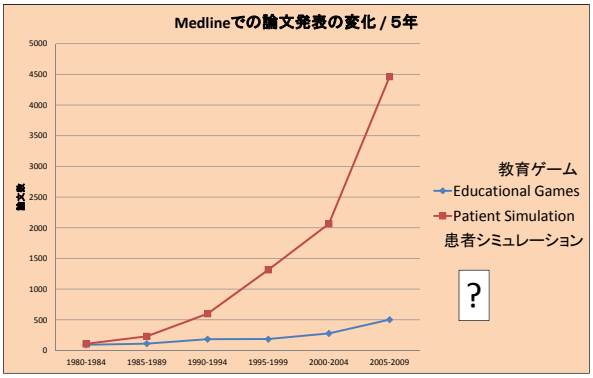
Dr. Glenn Clark
Dr. Luciano Nocera
Ostrow School of Dentistry
Univ. Southern Calif. [USC]



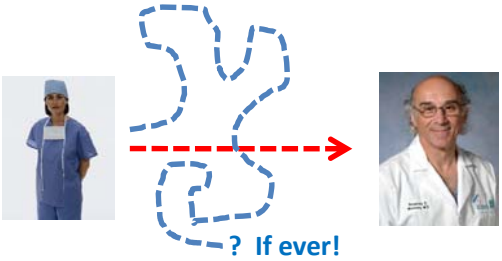
Trends in Medical Education



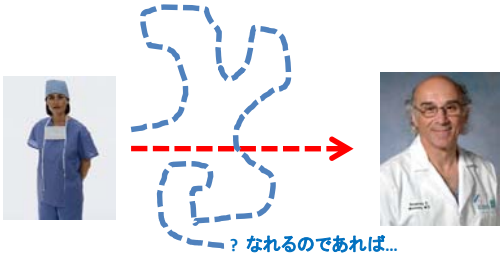
医学教育のトレンド（傾向）



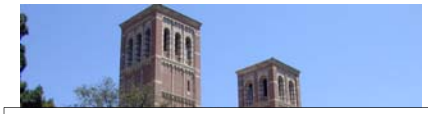
Alternate Title:
How long for a Novice to become an Expert?



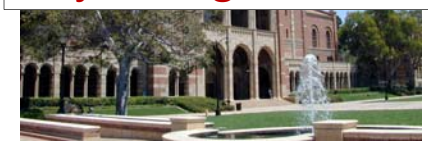
代行タイトル:
初心者がエキスパートとなるのに、どれだけの時間がかかるか？



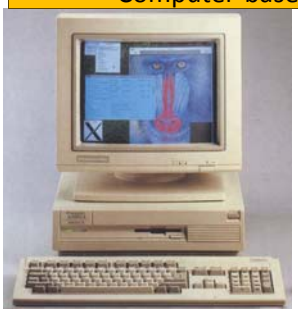
Q#1: When did we begin to create Virtual Patients?

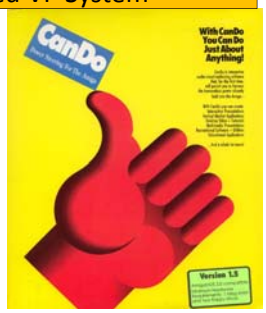


Project begun in 1988



Design#1: First Generation stand alone Computer-based VP System

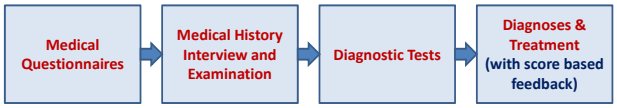




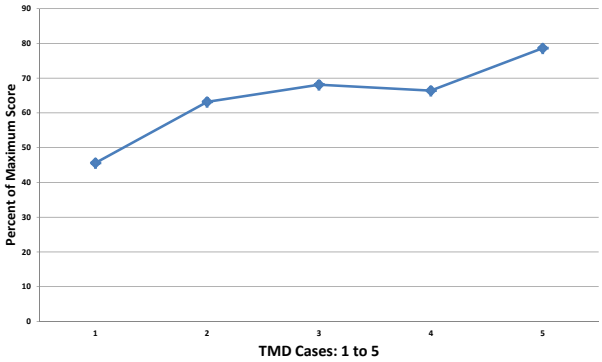
Clark GT, Koyano K, Nivichanov A. Case-based learning for orofacial pain and temporomandibular disorders. J Dent Educ. 1993 Nov;57(11):815-20.

1st Design: Linear Interactive Patient Scenario

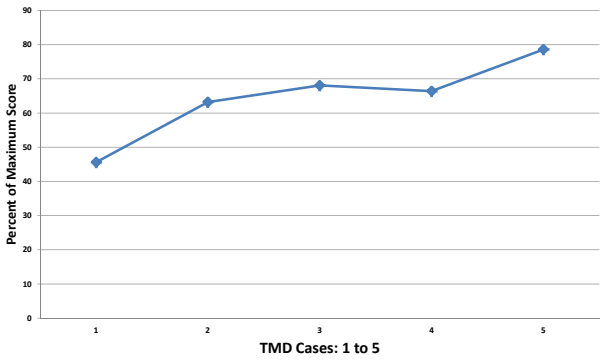
1. User clicks question (pre-determined)
2. Patient gives answers (data)
3. Data gathered is used to make decisions
4. Each decision = Yes/No result and Final Score.
5. Understand meaning of data = make better decisions.



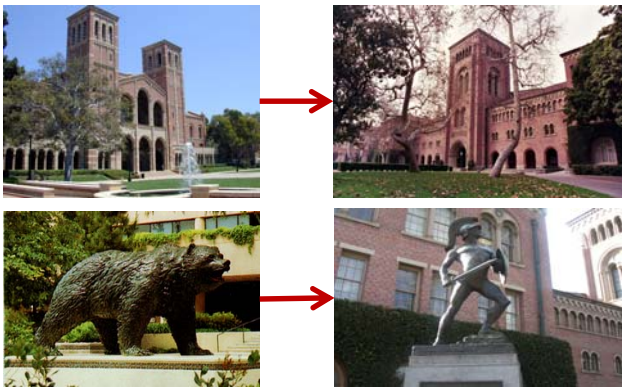
Final Score on 5 Consecutive TMD Cases using a Computer Case-Based System (3rd Year DDS students [n = 65])



コンピューター症例ベースシステム
顎関節症症例における5症例の試験点数
(歯学部3年生 [n = 65])



10 yr delay: I moved in 2003!



2 Basic Virtual Patient Styles

Branching, linked-page Non-Autonomous 2D VPs'

Pros:
- Button or narrative input (or both).
- Faster to operate (usually no typing)
- Based on commercial software.
- Easier to create and maintain!

Cons:
- Still text/image on a screen (engaging?)
- Does not force student to generate their own questions (engaging?)!

3D Autonomous VPs in a 3D virtual world

Pros:
- Makes student generate own Q's
- More Engaging and Immersive
- All dialog is captured for analysis

Cons:
- Question-Answer mismatch (~20%)
- Slower so students aren't as thorough
- Harder to create and maintain!
- Need C#, JAVA programmer/animator

仮想患者の2つのスタイル

分岐的、ページリンク、非自律的2D仮想患者

特徴:
- ボタンまたは文章による入力（両方）
- 操作時間が短い (タイプの必要無し)
- 既製ソフトを使用
- 作成とメンテナンスが容易

欠点:
- 文章と静止画像のみ表示 (参加的?)
- 学生自身で質問内容を考えさせることがない。(参加的か?)!

3D仮想現実内の3D自律的仮想患者

特徴:
- 学生自身が質問内容を考える
- より魅力的で夢中にさせる
- すべてのやり取りが記録・分析可能

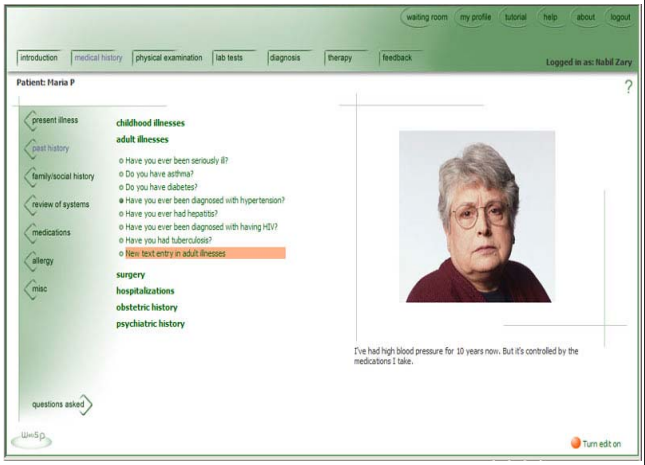
欠点:
- 質問と回答のミスマッチ(~20%)
- 時間がかかり、学生は大雑把になる
- 作成とメンテナンスが煩雑
- C#、JAVA プログラマー・アニメーターが必要

Q#2: In 2003, what VP systems were being used elsewhere?

Dr. Uno Fors (Professor)

Q#2: どのような仮想患者システムがすでに開発され実用されているか

Dr. Uno Fors (Professor)



Q#3: Since then how many new VP systems have been created?

Med. College of Georgia and Univ of Florida

Institute for Creative Technology, USC

Univ. Minnesota and VitalSims Inc.

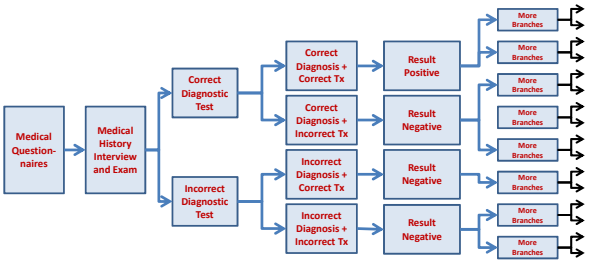
Texas A+M University & Breakaway, Inc

Duke University and Applied Res. Associates, Inc.

Stanford University CliniSpace

Multiple Branching Interactive Scenarios ($$$)

1. Patient images, audio, text files accessed with branching-tree structure.
2. These games are much longer because branching allows for great variation.
3. You could have the encounter show Sx progression with response to Tx.
4. Major drawback of branching scenarios is **complexity and authoring** effort.
5. Each branch causes a potential geometric increase in authoring effort.



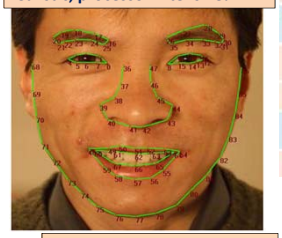
2012: Pulse!! Game

2012: HumanSim Game

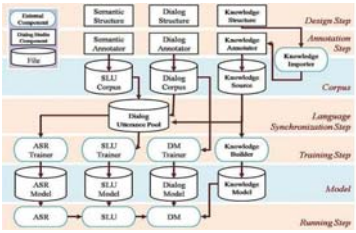
2012: CliniSpace Game

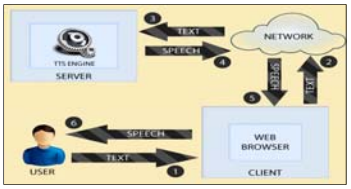
More Features: but can they be implemented on a tablet?

1. Functioning Face Engine: more realistic; processor intensive!



2. Dialogue manager lowers misrecognition; difficult to achieve; processor intensive!





3. Speech-to-Text Engines
4. Text-to-Speech Engines
- Both are nice features
- Slows game play
- Processor intensive
- Requires training

Dean's decision: "Duh!"

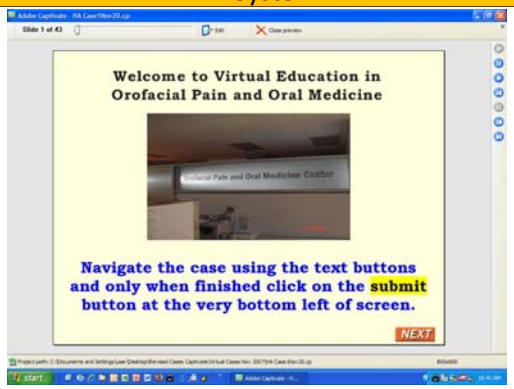
$70,000 (upgrades + IT support)

$1,000 (durable + students buy!)

Q#4: What did I elect to do in Virtual Patients at USC?

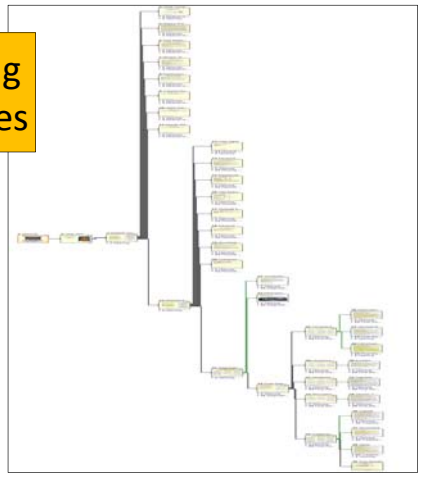
Q#4: USCで、VPを用いて何を実現したか?

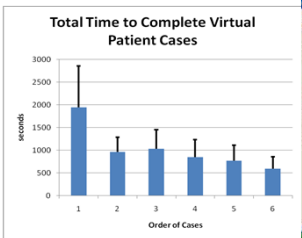
Design#2: Next Generation Web-based VP System

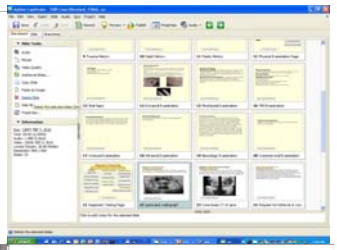


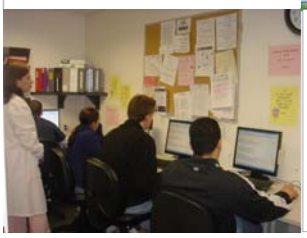
Branching algorithm style VP

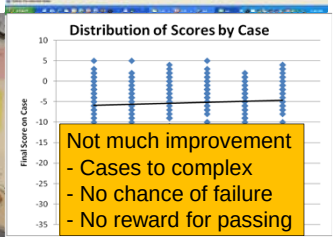
Branching Web Pages











Not much improvement
- Cases to complex
- No chance of failure
- No reward for passing

Q#5: How do we engage the student more?

Q#5: 生徒にどのように、より積極的に参加させるか

Design#3: 3rd Generation Virtual World-based VP System

Clark GT, Suri A, Enciso R. Autonomous virtual patients in dentistry: system accuracy and expert versus novice comparison. J Dent Educ. 2012 Oct;76(10):1365-70.

Study: examine performance of experts and novices on a virtual patient

1. VP designed as autonomous system using a NLP to recognized questions.
2. User interface was based in virtual world with movable avatars.
3. Experts were 10 boarded or board-eligible experts (7M:3F; age 40±11 yrs).
4. Novices were 26 fourth-year dental students (15M:11F; age 27±3 yrs).
5. 4 VP cases/user with an Orofacial Pain or Oral Mucosal/Salivary Disease.
6. After interview and mock exam users selected best DxTest, Dx, Tx and Rx.

Results:

1. Mean misrecognition rate for the NLP was between 13 and 19 percent.
2. Significant group difference existed for final total score achieved (Exp>Nov)
3. Significant group difference existed for # of DxTests ordered (Exp<Nov)
3. Significant group difference existed for # of Rx ordered (Exp<Nov)
4. Novices were very positive about the value of VP educational experience.
5. Groups asked almost the same questions and had similar encounter times.

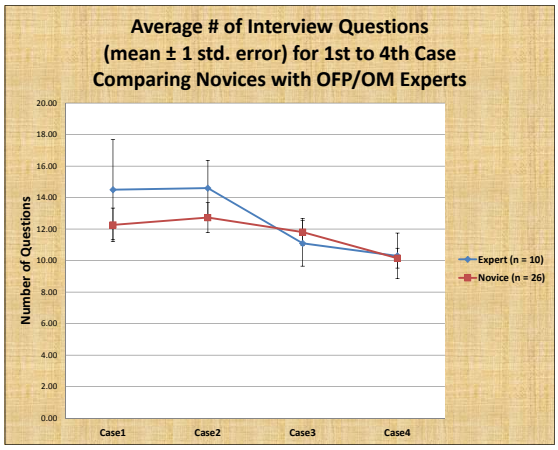
Conclusions: While they spent equal time and asked almost same questions, experts consistently scored higher and ordered fewer diagnostic tests and medications than the novices. This suggests clear difference in understanding of meaning of interview and mock exam data collected.

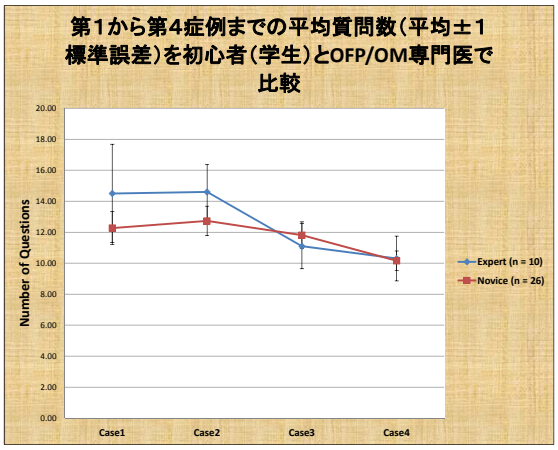
Q#6: What is the difference between a novice and an expert?

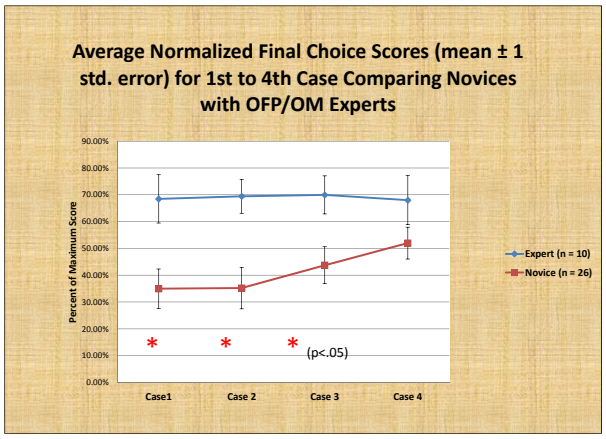
versus

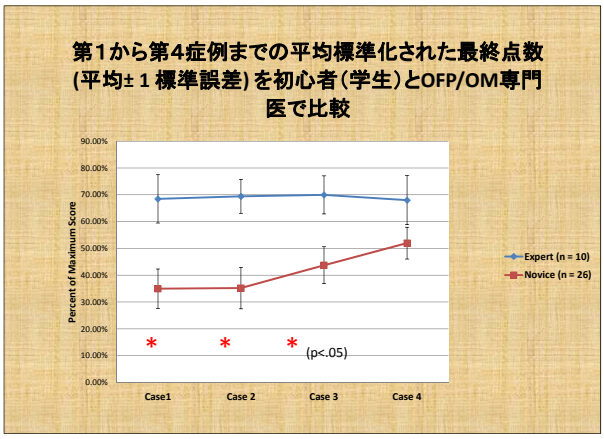
Q#6: 初心者とエキスパートの違いは何か?

versus

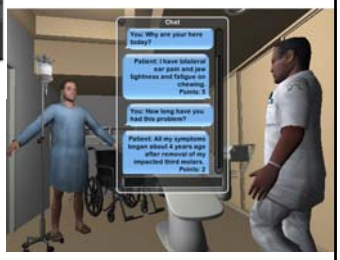






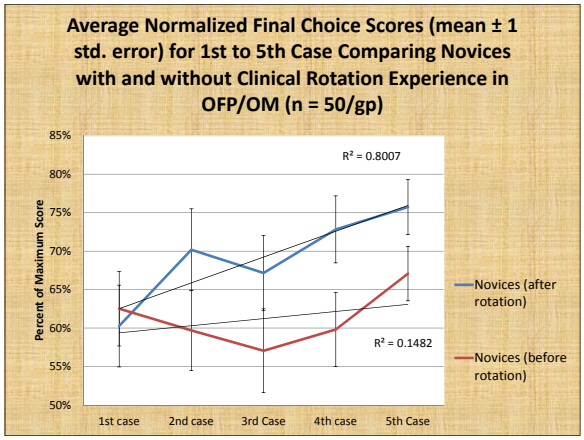


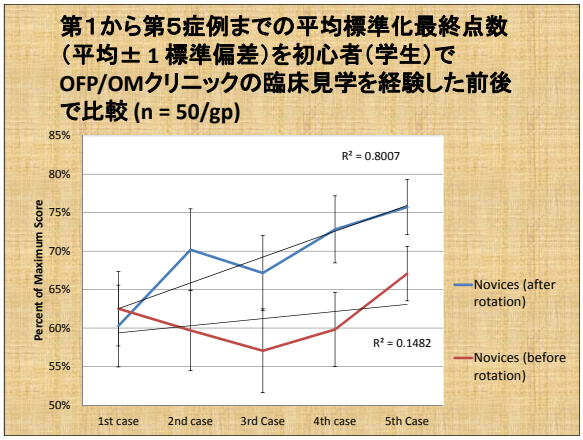
Design#4: Fourth Generation hosted in Unity 3D



Q#7: What is the value of clinical observation?

Q#7: 臨床見学の重要性とは？





Problem: What are they learning by watching? (Some but not enough!)

Solution: Add VP cases to rotation.

問題点: 見る事でなにを学んでいるのか？ (多少、しかし不十分)

How about other Virtual Patient research?

Q#8: Can Virtual Patients be used to successfully teach medical students how to interview and diagnose a new patient?

Answer: Yes and it was rated equivalent to SP system

Q#8: 仮想患者による学習は、医学部学生に、どのように新患の医療面接と診断を行うかを教育するのに有効か？

解答：はい、模擬患者と同等であると評価されました。

Stevens A, et al. The use of virtual patients to teach medical students history taking and communication skills. Am J Surg. 2006 Jun;191 (6):806-11.
Study: assess virtual patient with acute abdominal pain as teaching model.
1. Goal: VP to teach medical students history-taking and communication.
2. Setting: Wall projection of VP in an examination room.
3. Context: student reviews patient information on tablet before encounter.
4. Task: student directed to take a history and develop differential Dx.
5. Method: 2 linked PCs, projector, 2 Webcams tracking head/hand motion
6. VP responds with specific answers/gestures after each question.
7. VP response were based on Standardized Pts responses to students.
8. Subjects: 20 students (after voice recognition training) asked questions.
9. Outcomes: Maastricht Simulated Patient Assessment method.
10. All participants had prior experience with real SPs.

Results:

1. **The VP correctly recognized 60% of the student's questions**.
2. Student rated VP favorable, particularly the feedback by virtual instructor.
3. Overall student rating was between 6.5±1.6 and 7.5±1.2 on 10 point scale.
4. **Performance on VP compare favorably to a student scores on real SPs.**

Conclusion: VP technology provided students with a controlled, secure, safe learning environment with the opportunity for repetitive practice.

Q#9: Are there some situations where a Virtual Patient is better than a Standardized Patient?

Answer: In one specific case VP was clearly better but probably not overall!

Q#9: 仮想患者が模擬患者よりも優れている場面はあるか？

解答：ある特定の条件では仮想患者は明らかに模擬患者より優れていたが、恐らくすべての状況でそうとは言えないだろう。

Wendling AL, et al. Virtual humans versus standardized patients: which lead residents to more correct diagnoses? Acad Med. 2011 Mar;86(3):384-8.

Study: compare prevalence of correct Dx using similar SP vs VP cases.

1. Case included Hx features of OSA (snoring, hypersomnolence, observed apnea, hypertension, and obesity).
2. Three SPs (in 2008) and one VP (in 2009) were used in this study.
3. VP had physical appearance of OSA case (morbidly obese and large neck).
4. VP airway images showed redundant soft tissue, large tongue, and tonsils.
5. VP had 259 answers triggered by 849 questions available.

Results:

1. 5 of 21 residents (23.8%) suspected OSA after interviewing the SPs.
2. 11 of 13 residents (84.6%) suspected OSA after interviewing the VP.
3. Difference was statistically significant (OR: 17.6; 95% CI of 2.9-107).

Conclusions: Interviewing a physically appropriate VP versus a trained but physically incorrect SP resulted a much higher accuracy rate in the resulting diagnosis.

Q#10: What is effect of time constraints on diagnosis as students try to integrate clinical/lab data during a virtual patient work-up?

Answer: time constraints for novices caused higher errors!

Q#10:仮想患者の診査で、時間制限はどのような影響を及ぼすか

解答: 初心者に制限時間を設けると、誤答の可能性が高くなる

Gunning WT, Fors UG. Virtual patients for assessment of medical student ability to integrate clinical and laboratory data to develop differential diagnoses: comparison of results of exams with/without time constraints. Med Teach. 2012;34(4):e222-8.

Study: evaluate effect of time limitations on performance in VP-based exam.

1. Gp 1: 155 2nd yr medical students given unlimited 1 week assess to VP case.
2. Gp 2: 175 2nd yr medical students given same VP case with 3-hr time limit.

Results:

1. Gp 1 (without time constraints) spent 2x more time on VP case than Gp 2.
2. Gp 1 (without time constraints) asked 50% fewer questions than Gp 2.
3. Time constriant students used a "shotgun approach" to try to collect as many "required" inquiries as possible.
4. 91% of Gp 1 (without time constraint) were able to correctly diagnose case.
5. 31% of gp 2 (with time constraint) correctly diagnosed the case.

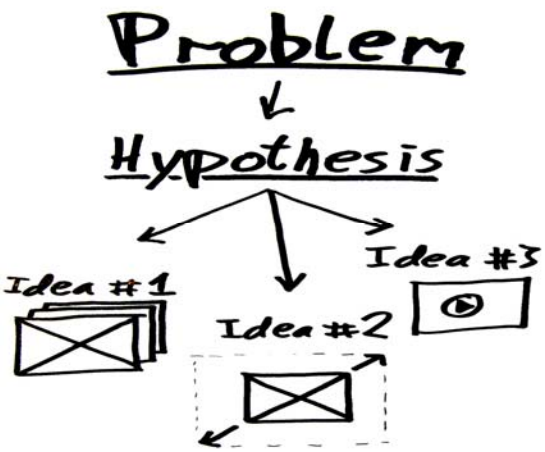
Conclusion: VP exams, administered with and without time constraint resulted in very different performance. It is possible that time limitations unravel student's ability to integrate the new data discovered during the process of progressive disclosure.

Q#11: Does testing the hypothesis derived from history, as you perform exam, improve diagnostic accuracy?

Answer: Yes! [and if additional data has some inconsistencies with initial history this may improve diagnostic accuracy]

Q#11: 診査を行う上で、医療面接から得られた仮説を検証する事は診断の精度を向上させるか。

解答：はい。もし、追加のデータが医療面接と一致しない場合、診断の精度を向上させる。



s.

Q#12: Does formal training in the process of "hypothesis testing" improve diagnosis skills?

Answer: Yes, IHT better than PBL trained students!

Q#12: 仮説を反復検証する事を正式に訓練すれば、診断能力向上につながるか。

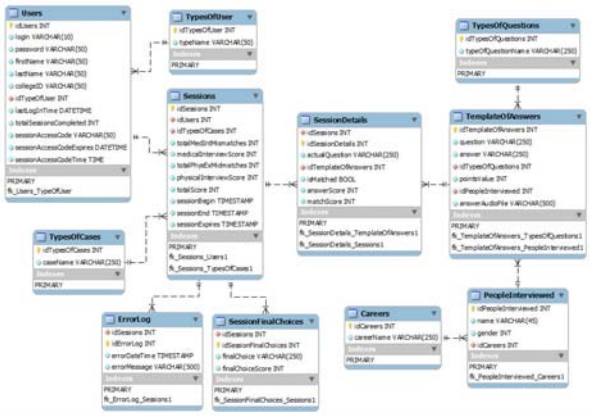
解答：はい、IHT（仮説の反復検証）はPBLよりも効果的である。

Kahl KG, et al. A randomized study of iterative hypothesis testing in undergraduate psychiatric education. Acta Psychiatr Scand. 2010 Oct;122(4):334-8.
Study: RCT created to compare problem-based learning vs IHT.
1. IHT is iterative hypothesis testing.
2. MCQ used to get baseline assessment of knowledge and skills
3. Subjects: 71 medical students taking class in psychiatry.
4. Two groups: (#1) received problem-based learning (#2) received IHT.
5. Final exams based on scores from MCQ and simulated patient encounter.
Results:
1. Gp 2: IHT-trained students recognized more diagnostic items, comorbid psychiatric disorders and acute suicidal tendencies than PBL-trained group.
2. No group difference in acquisition of general psychiatric knowledge.
3. No group difference in global satisfaction with the course.
Conclusion: teaching IHT to medical students may enhance their clinical ability to recognize complex disease patterns in psychiatry.

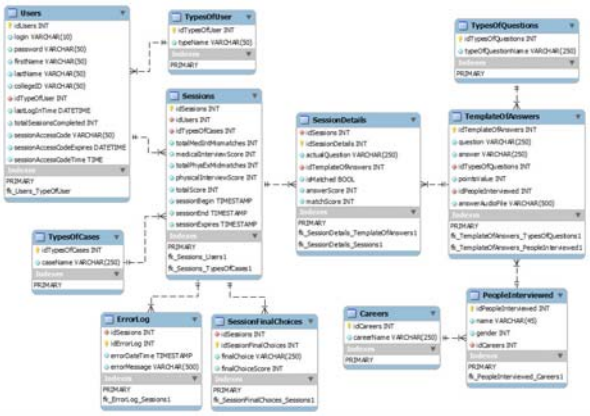
Q#13: How do we measure efficiency and performance?

Q#13: 効率とパフォーマンスをどのようにして測るか?

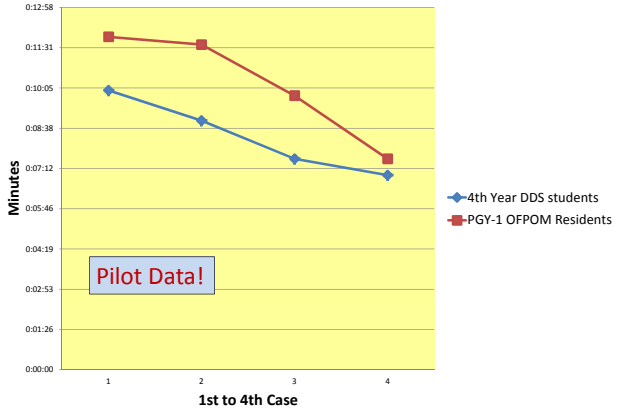
Fourth Generation Web-based + SQL-DB VP System



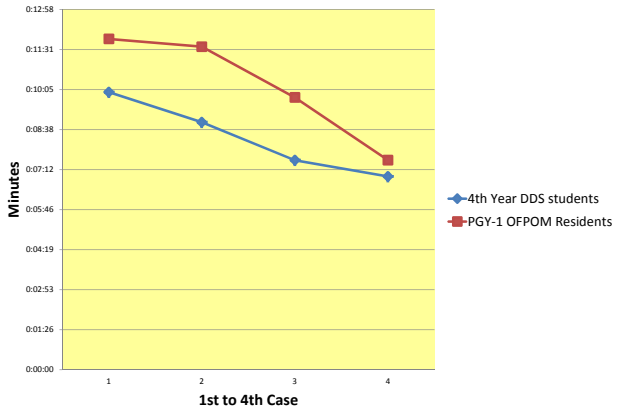
Design#5: Fifth Generation Web-based + SQL-DB VP System



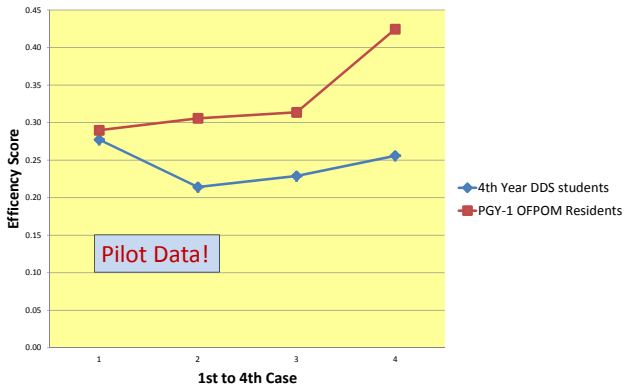
Total Time Asking Questions



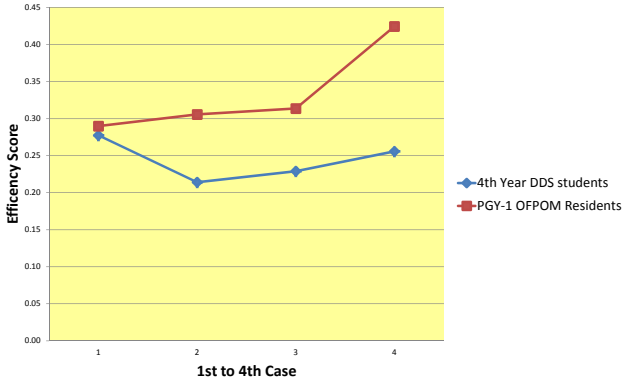
質問を聞くのに費やした時間



Overall Efficiency Score [Case Score/Min per HVQs]

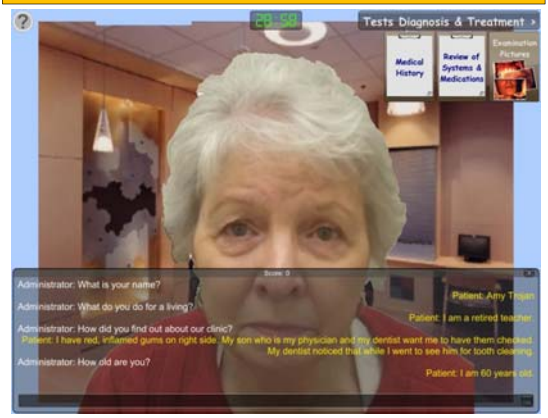


全体的な効率スコア [症例の点数/HVQを聞くにかかった分数]

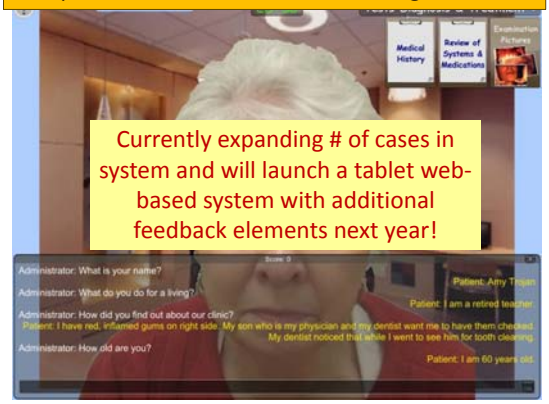


2014: Can we make the virtual patient platform system even better?

Next Generation: Avatar + Web-based + SQL-DB VP System



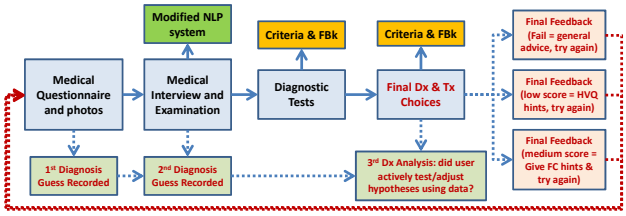
Design#6: Six Generation: NLP-Avatar (TTS ??) + Improved Feedback & Case Authoring Features



Currently expanding # of cases in system and will launch a tablet web-based system with additional feedback elements next year!

Linear VP interactions with branching and hypothesis testing

1. Uses modified NLP system accepting new Q's and menu Q's.
2. Provides criteria before and feedback after each choice.
3. Gives final screen providing individualized hints retry options
   (a) failing performance = give general advice & repeat case.
   (b) low score: access Q's asked & suggest new HVQ's + repeat.
   (c) medium score: access FC's & give criteria for wrong FC's.
4. Gather 1st & 2nd Dx-Ho to see if user actively tested Dx-Ho



Final Question: Does a Virtual Patient experience improve students' clinical reasoning skills.

最後の質問:仮想患者(VP)で学習することで、学生の臨床推論能力は向上するか？

Absolutely!

- More VP training = improved case scores.

[would it improve faster with formal IHT training?]

- More VP training = better user efficiency.

[need to identify, track + train how to find HVQ's?]

- VP training supplements clinical training?

[would interactive VP be >/= clinic observation?]

- VP training can be more engaging.

[which game elements are most important?]

----------other theories which need testing----------

- Ho1: lower medical mistakes.
- Ho2: reduce unneeded healthcare costs.
- Ho3: reduce cost of training MD/DDS/RN

もちろん!

- VPトレーニング= 症例の点数を改善.

[正式なIHTの練習によりさらなる改善が望めるか?]

- VPトレーニング= ユーザーの効率を改善.

[HVQを識別し、追跡する必要がある]

- VPトレーニングは臨床訓練の補足となる.

[魅力的な仮想患者システムは臨床見学と同等か ?]

- VPトレーニングは生徒により魅力的である.

[ゲーム要素をより向上させる必要がある]

- Ho: 医療過誤の減少.
- Ho: 不要な医療費の削減
- Ho: 医師・歯科医師・看護師の教育費削減

The End! Thank you & remember
"The future is ours to create!"

ありがとうございました
"未来は我々が創る!"