&RS\ULJKW

'HYHORSHG DQG SXEOLVKHG XQGHU FRQWUDFW EHWZHHQ WKH 1HZ <RUN 6WDWH (GXFDWLRQ 'HSDUWPHQW DQG 3HDUVRQ

&RS\ULJKW\ WKH 1HZ <RUN 6WDWH (GXFDWLRQ 'HSDUWPHQW

6HFXUH 0DWHULDOV

$OO ULJKWV UHVHUYHG 1R SDUW RI WKLV GRFXPHQW PD\ EH UH
8VH RI WKHVH PDWHULDOV LV OLPLWHG WR WKH 1HZ <RUN 6WDWH (G

1< 5HJHQWV WHFKQLFDO 5HSRUW IRU 1<6(' E\ 3HDUVRQ

&RQWHQWV

&+$37(5 ,1752'8&7,21

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7$5*(73238/$7,216 67$1'$5'

&+$37(5 &/$66,&$/ ,7(0 67$7,67,&6 67$1'$5'

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6800$5<

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&KDSWHU ,QWURGXFWLRQ

,1752'8&7,21

7KLV FKDSWHU SURYLGHV DQ RYHUYLHZ RI WKH 1HZ <RUN 1< /HDUQLQJ 6WDQGDUGV 3URMHFW DQG WKH 5HJHQWV ([DPLQDWLRQV 7KH FKDSWHU GHVFULEHV WKH QHHG IRU WKH QHZ VWDQGDUGV DQG WKH SURFHVV XVHG WR GHYHORS WKHP 7KH FKDSWHU DOVR GLVFXVVHV WKH QHHG IRU FKDQJHV LQ WKH 5HJHQWV ([DPLQDWLRQV DQG WKH SURFHVV XVHG WR PDNH WKRVH FKDQJHV &KDSWHU DOVR SURYLGHV DQ RYHUYLHZ RI WKH UHVW RI WKH UHSRUW

7$5*(7 3238/$7,21 67$1'$5'

7KH VWXG\ SRSXODWLRQ JHQHWLF GDWD DQG SRVHG RI VWXGHQW KDYH FRPSOHWHG DW OHDVW RQH SRVHG RI VWXGHQWV D GHPRJUDSKLF EUHDN VWXGHQWV ZKR WRRN 5HJHQHWLF-XQH[DPL*HQRWHRVQOLQH DQDO\VLV SRLQWWKL DUH EDVHG RQ WKH SRSXODWLRQ GDWD LQ WKH 1HZ <RUN 6WDWH 5HSRUW &DUGV DUH WKRVH UHSRUWH 6\VWHP 6,56 DV RI WKH UHSRUWLQJ GHDGOLQH WKH HQWLUH VHW RI VWXGHQWV DG VHHKWWSV GDWD,QDVWXGHQW WDNHV WKH VDPH H[DP PXOW RQO\ WKH KLJKHVW VFRUH LV HQWHUHG LQ -XQH[DPL*HQRWHRVQOLQH DQDO\VLV SRLQWWKL ZDV RQO\ DGPLQLVWHUHG LQ WKLV UHSRUW DUH UHSRUWHG XVHG WKH DQDO\VHV LQ WKLV UHSRUW DUH UHSRUWHG XVLQJ GDWD IURP FROOHFWLRQ V\VWHP 7KHVH GDWD LQFOXGH DOO VWXGHQW UH QFRXQWHUHG VWXGHQW UHSRUW ZLOO GLIIHU IURP SXEOLVKHG UHSRUW

7DEOH 7RWDO 6WXGHQW 5HSRUWV ([DPL*HQRWHRVPHWU\

'HPRJUDSKLFV	1
$OO 6W	
5DFH (WKQLFLW\	
$PHULFDQ ,QGLDQ	
$VLDQ 1DWLYH +DZDLLDQ 2	
%ODFN $IULFDQ	
+LVSDQLF	
0XOWL	
:KLWH	
(QJOLVK /DQJXDJH/HDUQHU	
1R	
<HV	
(FRQRPLFDOO\ 'LVDGYDQWDJ	
1R	
<HV	
*HQGHU	
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0DO	
1RQEL	
6WXGHQW ZLWK D 'LVDELOLW	
1R	
<HV	

7KUHH

7DEOH &5WHP $QDO\VLV 5HSRUW ([DPLQDWLRQ\

,WH	6WXGH	0LQ 6FRU	0D[6FRU	0HDQ	6'	S9DOX	3RLQ %LVHU

7KH 5DVFK PRGHO SHUIRUPDQFH GDWDEDVH FRQWDLQV LQIRUPDWLRQ RQ WKH
ORJLWV RQ FRUUHFW DQVZHUV DQG UHVSRQVH WLPHV RQ WKH PRGHO DVVXPSWLRQV
HVWLPDWHV WR XQGHUVWDQG LWHP GLIILFXOW\ WKDW DUH WKH
VDPSOHV RI WKH GHSHQGHQW YDULDEOH

62)7:$5($1' (67,0$7,21 $/*25,7+0

,WHP FDOLEUDWLRQ ZDV LPSOHPHQWHG YLD WKH 1, 6WDWH(36 FL
ZKLFK HPSOR\V QRQOLQHDU RSWLPL]DWLRQ WR &RPSXWH 0/(DQG

,7(0 ',))&8/7< 6<67(0 3(5)250$1&(0$3

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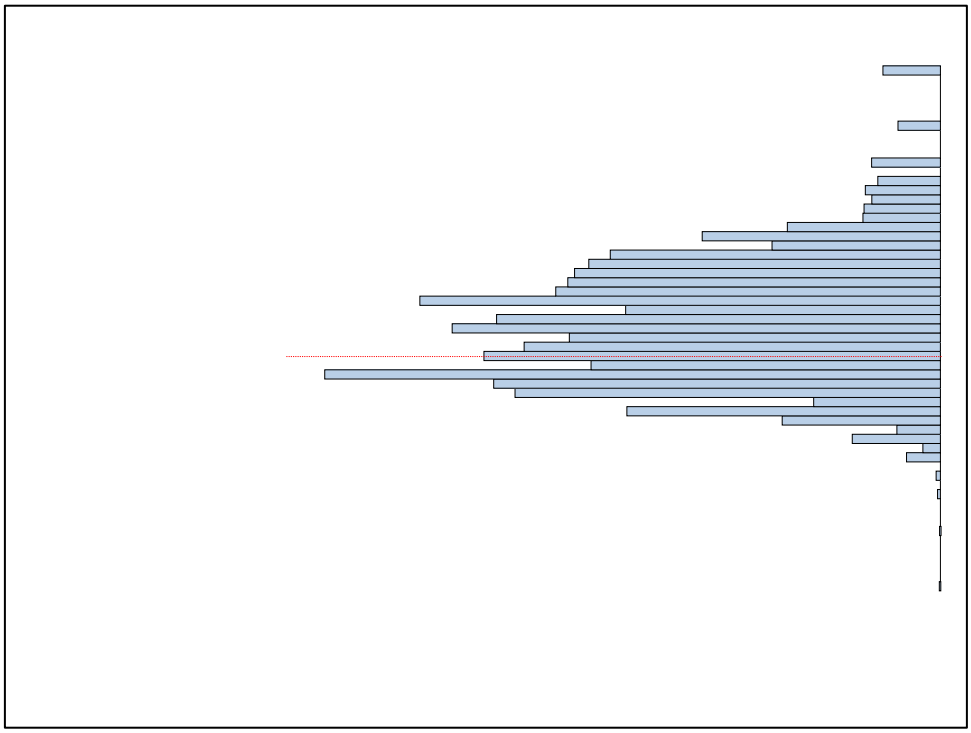
VKRZQ RQ WKH LWHP PDS 7KLV JUDSKLF LOOXVWUDWHV WKH ORFDWLRQ RI VWXGHQW SHUIRUPDQFH DQG
WKHLU UHVSHFWLYH GLVWULEXWLRQV DQG FXW VFRUHV LQGLFDWH
VKRZV PRUH GLIILFXOW LWHPV DQG ORZHU DELOLW\ VWXGHQWV DW WKH WRS DQG ORZHU
HDVLHU LWHPV DW WKH ERWWRP

)LJXUH 6WXGHQW 3HUIRUPDQFH 0DS 5HODWLRQVKLS LQ



&+(&.,1* 5$6&+ $66803,216

%HFDXVH WKH 5DVFK PRGHO WDV WKH EDVLV RI DOO FDOFXODWLRQV
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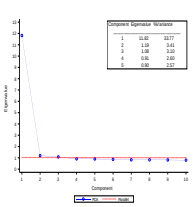
UHVXOWV GHSHQGV RQ WKH GHJUHH WR ZKLFK WKH GDWD
PRGHO ILWV WKH WHVW GDWD 7KHUHIRUH LW LV LPSRUWDQW
HYDOXDWHV WKH GLPHQVLRQDOLW\ RI WKH EDVLV RI VWXGHQW VFRUHV
LWHPV ZHUH DQDO\]HG WKH EDVLV RI VWXGHQW VFRUHV

5DVFK PRGHOV DVVXPH WKDW RQH GRPLQDQW YDULDWH SHUIRUPV 3&$ FDQ EH XVHG WR DVVHVV W DVVXPSWLRQ 7KH SXUSRVH RI WKH H[HUFLVH GRHV QRW UHTXLUH GHWDLOHG FRPSL H[LVW DPRQJ ,WKDQ\LPVWRU GLPHQVLRQV DUH IRXQG WR XQGLP EH YLRODWHG

$ SDUDOOHO DQDO\VLV +RUQ ZDV FRQGXFWHG WR KHOS GL FRPSRQHQWV DUH LGHQWLFDO LQ SRSXODWLRQV DQG GLIIHUHQW H[LVW LQ SRSXODWLRQV VHTXHQFHV PXVW EH IDFWRUV RULJLQDWHG)RU HDFK UDQGRP VDPSOH WKH XSSHU WK SHUFHQWLOH HLJHQYDOXHV IURP WKH WUDQVIRUPHG *UDVVPDQ GLVWDQFH IRU WKH SDUDOOHO DQDO\VLV WKH UHIHUHQFH OLQH LV HVVHQ DQ HLJHQYDOXH RI

)LJXUH SUHVHQWV $ DQG SDUDOOHO EHWZHHQ 5HVXOWV ([DPLQDWLRQ *HRPHWULF UHVXOWV LQFOXGH WKH HLJHQYDOXHV DQG WKH SHUF ILUVW ILYH FRPSRQHQWV DQG WKH VFUHH SORWV 7KH VFUHH SORWV FRPSRQHQW QXPEHU DQG WKH UHVXOWV ™`sI•KH SH

)LJXUH 6FUHH 3ORW 5HJHQWV*H[RPHWULF LQ



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:,167(36 SURYLGHV WZR L,WHDQ2/7VWDWLWWDEXDWLQJ WKH GHJU
WKH 5DVFK PRGHO SUHGLFWV WKH REVHUYHG LWHP UHVSRQVHV
VWDWLVWLF FDQ EH H[SUHVVHG DV DRUHDQDVTXDUHGDUGLHGWHV
ZLWK PHDQ DQG YDULDQFH 0Q6T YDOXHV DUH PRUH RULH
ZKLOH =VWG YDOXHV DUH PRUH RULHQW,1)7QRZDUGOXWVDULWW
DYHUDJH RI VWDQGDUGL]HGFHUWLKHDOIIHUHQFH EHWZHHQ WKH
5DVFKVWLPDWHG VFRUH GLYLGHG E\DWKRVHTXDUHURRWRI WKH
VWDWLVWLF LV ZHLJKWHGEWKDWRQGMREWHG PRUH E\ XQH[S
UHVSRQVHV FORVH WR WKH SHUVRQ LWHP LRULQUDWLQJHQFDW
UHVSRQVHV

7KH H[SHFWHG 0Q6T YDOXH LV DQGLQWDUJHYLDWLRQ LQ
H[SHFWHG YDOXH FDQ EH LQWHUSUHWHG DV QRLVH RU ODFN RI
ORZHU WKDQ WKH H[SHFWHG YDOXH FDQ EH LQWHUSUHWHG DV
SUHGLFWDEOH WRR PXFK UHGXQGDQF\KH DQ[SHFWHGYDOXH

7KH 5DVFK GLIILFXOW\ SDUDPHWHUV IRU WKH LWHUDWLYH RQUDZ ED
VFRWWRDVFK VWXGHQW DELOLW\ WKHWD VFRUH UHODWLRQVKLS
WKH 5DVFK WKHWD VFRUH DQG WKH VFDOH VFRUH WR EH NQ
UHODWLRQVKLS ZLWK WKH HUDZLQJ UHDVRQV ZDV WHVWHG IURP

1< 5HJHQHWHUDWHG IRU 1<6(' E\ 3HDUVRQ

5HOLDELOLW\ LV PRVW RIWHQ HVWLPDWHG XVLQJ WKH VDPH GRPDLQ
SUDFWLWLRQHUV DQG UHVHDUFKHUV LQ WKH ILHOG RI VRIWZDUH HQJLQHHULQJ DV W
ZKLFK DQ H[FKDQJHDEOH VHW RI LWHPV IURP WKH VDPH GRPDLQ
RI VWXGLHV HQDEOHV UHOLDEOH LQWHUSRODWLRQ RI VXFK PHDVXUHV
IURP RQH VDPSOH RI LWHPV WR WKH QH[W VKRXOG EH RI SDUW
XVHU $ JHQHUDO FRPSXWDWLRQDO PRGHO RI PHDVXUHPHQW

ZKHUH WKH QXPEHU RI PHDVXUHG [FH` õ°`úãÒp

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7DEOHSUHVHKQWRVHWLFDOHSQDQG DVVRFLDWHGG KHO 5HJHQWV ([DPLQD
*HRPHWU\

7DEOH&RHIILFLHQWSQOSKEJHQWV ([DPL?HWRPHWULQ

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$VVXPLQJ QRUPDOLWXWHG VFRUHV RQHWZRXGG IRISWKW RE EVRXWY
EH ZLWKLQ RQH VWDQGDUG GHYLDWLRQ RI WKH PHDQ $Q HVWL
VFRUHV FDQ EH FRPSDUHG DV

(YHU\ WLPH DQ DVVHVVPHQW WLXGHGRWLRQLFRQHWUHLQ,V WKHHVHUR
H[DP ZHGHFLDLHGDQHULQILQLWH QXPEHU RI WLPHV WR WKH VDPH
GLVWULEXWLRQ RI WKH VWXGHQW¶VKWDXGWRXWHVFRUHVWHQGHE H TX
VFRUH REWDLQHGDZLGVKHR VHWDRGDUG GHYLDWLRQ DQGHVWL
VFRUHV ZRXOG EH WKH FRQ%LHFDXKHU WLWRGDUGHUHUHSRQGH
EHWZHHQ WKH UDLZVFRUH5DQGK PRGHFDQEKLVSHSRQHHGDQHU\
DOO VWXGHQWV ZKR REWDLQHGGDWSKHUSULRUEOLWZ RFRUHWDLQ
UDZ VFRDQH EH FDOJEXHQWWKGHQHWLPDWHG VWDQGDUG GHYLDWL
FRQGLWLRQDO GLVWULEXWLRQ LV GHILQHG DV WKH &6(0 7KH F
ZDV XVHG WR FDUU\ RXW WKH PHFKDQLFV RI WKLV FRPSXWD

7KH UHODWLRQVKQSGEWKHZVFDOHRWFRUHSUHVLEOH LQ D VLPSOH F
EHFDXVLW IDWEOHQIRXGWKKHH SRO\QRPLDO UHODWLRQVKLS EHWZ
VFRDHQWKH QRQOLQHDU UHODWLRQVKLS EHWZHQ,QWKHGSLFWHQH
H[DPòCw4€]

FRXOG EH WKLV QDPH WHVW PXOWLSOH WLPHV EHFDXVH WKH GLVWULEXWLRQ ZRXOG EH WKH FRQGLWLRQDO GLVWULEXWLRQ RI WKH PHDQ YDOXH HVWLPDWHG IURP VDPSOHV RI UDZ VFRUH 7KLV &OHDUO\ IRU UDZ VFRUH PHWULF LV WKH VTXDUH URRW RI WKH YDULDQFH RI

1< 5HJHQHUDWHG IRU 1<6(' E\ 3HDUVRQ

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,Q D VWDEOH GHVLJQ SURJUDP WHVWLQJ LV D PQWHUHVW LQ NQRZLQJ KRZ D
FODVVLILHG LQWR SHUIRUPDQFH WKHRUHWLFDO SRSXODWLRQV WKDW FRQWULEXWH
WKH UHODWLYH LPSRUWDQFH RI VWXGHQWV LW LV WKH DEVROXWH QXPEHU
LQ GHFLVLRQ FRQVLVWHQF\ DQG DFFXUDF\

&ODVVLILFDWLRQ FRQVLVWHQF\ UHSHDWDELOLW\ RI GHFLVLRQV ZKHQ
FDQ EH UHSOLFDWHG XSRQ UHWHVWLQJ XVLQJ DQ HTXLYDOHQW
DQVZ@wÂ Or UFUDWE RI QUFDWEVP`Hu€Q@W™VUHFDWKEHQ UK PUDQKH

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7DEOH 'HFLVLRQ &RQVLVWHQF\ DQG 5HJHQHUDF\ ([DPSOH

6WDWL\				
&RQVLV $FFXU				

*5283 0($16 67$1'$5'

7KH VWXGHQWV RQ WKH OLVW DJUHHG WKDW WKH PHDQLQJ RI VWXGHQW KDYH FRPSOHWHG EHFRPH FRQIXVHG DQG WKH\ FRPSXWHG WKH PHDQ RI DOO WKH

7DEOH *URXS 5HJHQWV ([DPLQDWLRQ

'HPRJUDSKLFV	0HDQ 6WXGH	6' 6FRUH	6FRUH
$OO 6W			

&RQWHQW YDOLGLWWKH FRQFHUQHG ZLWK

)LJXUH 1<6(' 7HVW 'HYHORSPHQW 3URFHVV

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DUH XVHG WR KWHOSWHQWXGHQWV XQGHUVWDQGGHKWWKDWKH
ODQJXDJHLWQGRHVH QRW DGYHUVHO\ DIIHFW D VWXGHQW¶V DELO
6LPLODUYHQWKLWFLWWHULD DUH XVHG WLRHDVXQEHDZKHGWKQRU
RIIHQVLYH DQG QRW GLVDGYDQWDJHRXWWHQLXEJURX
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7KH WKLUG FDWLJRU\RIKQHGGWHVVHV KRZ HDFK LWHP PHDV
PDWKHPDWLFV VWDQGDUG 7KLV FULWHULRQ DVNV WKH UHYLHZ
LWHP DGGUHVVHV DQG FDOOV IRU WKH 7KHLOHFULWHULRQ E\ W
UHYLHZHUV WR FRPPRQHQWKDQQKRQH VWDQGDUG LWHDKGURXWG E\
FDWHJRULWHUDPHZRUGGUHVVHV WKH GHPDQGV IRU GLIIHUHQW L
5HYLHZHUV HYDOXDWH HDFK LWHP WR HQVXUH WKDWHLWPSRQIRU
0&LWHP PXVW RKQHYHQDPEL\JXRXV

1 < 5 H J H Q W V

7 K H

7KH 0DQFKHVWHU &LW\ +DOO +DV VWDQGDUGL]HG 'RUDQV GLIIHUH
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UHIHUHQFH DQG IRFDO JURXSV FRPELQHG RYHU YDOXHV RI WK
PHDQVWDWXHVSRQVH HDUQLQJ D VFRUH RI RQ DQ LWHP LV EHW
RI D LV EHWWHU WKDQ DQG VR RQ ³&RQGLWLRQDO ´ RQ W
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DO

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EH\RQG WKH H[SOLFLWO\ GHILQHG

5HIHUHQFHV

$PHULFDQ (GXFDWLRQDO 5HVHDUFK $VVRFLDWLRQ $QQXDO 0HHWLQJ 3URFHHGLQJV $VVR
3 1DWLRQDO &RXQFLO RQ 0HDVXUHPHQW LQ (GXFDWLRQ
$(5$

%DUNDRXL (IIHFWV RI PDUNLQJ PHWKRG DQG UDWHU H[SHULHQF
UDWHU SHUIRUPDQFH

%UHQQDQ 5 /
&RPSXWHU VRIWZDUH 9HUVLRQ
,RZD

&KHQ : + 7KLVVHQ ' /RFDO GHSHQGHQFH LQGH[HV IRU
UHVSRQVH WKHRU\ ±

&RQJG&RQJG#rOP FVi#• D

FRQGXFWHG GXULQJ WKH UHYLHZ SURFHVV DQG FROOHJ
EH\RQG WKH H[SOLFLWO\ GHILQHG